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THE FOUNDRY

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ESTABLISHED 1874

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702 Pure Ceylon Plumbago

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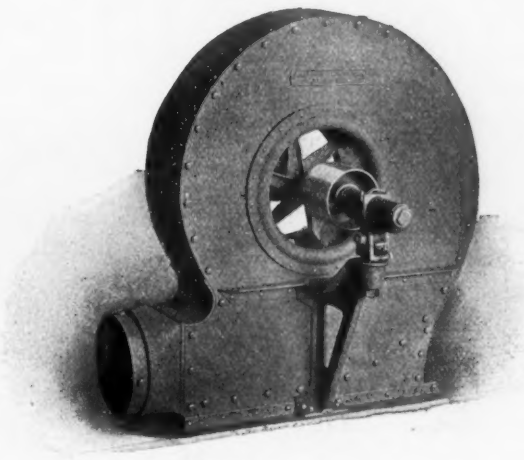

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(Continued from last issue.)

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Mechanical Efficiency	Ratio about 60	to 40
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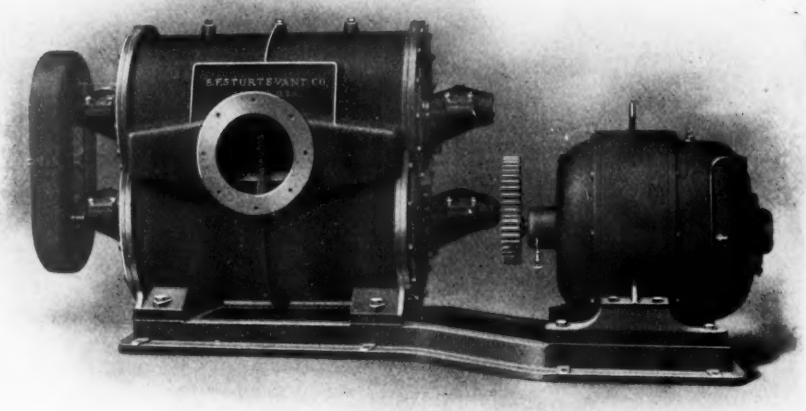

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565

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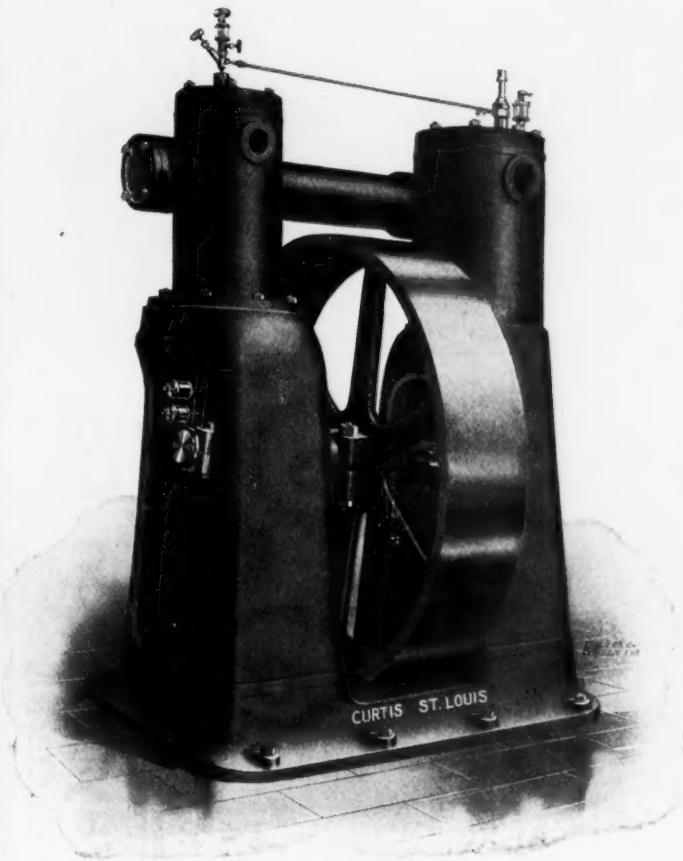

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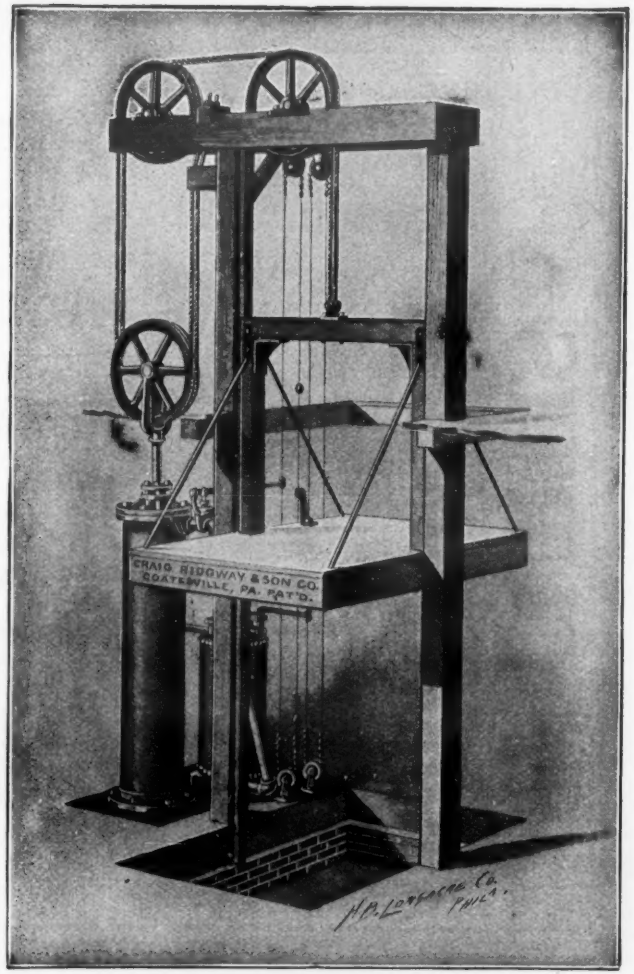

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Number three the popular size

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Special shapes made to order.

Conveyor Screws cast and hardened or provided with steel points.

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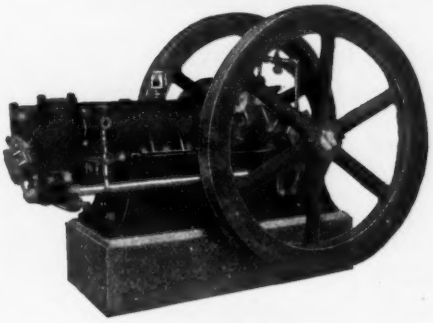

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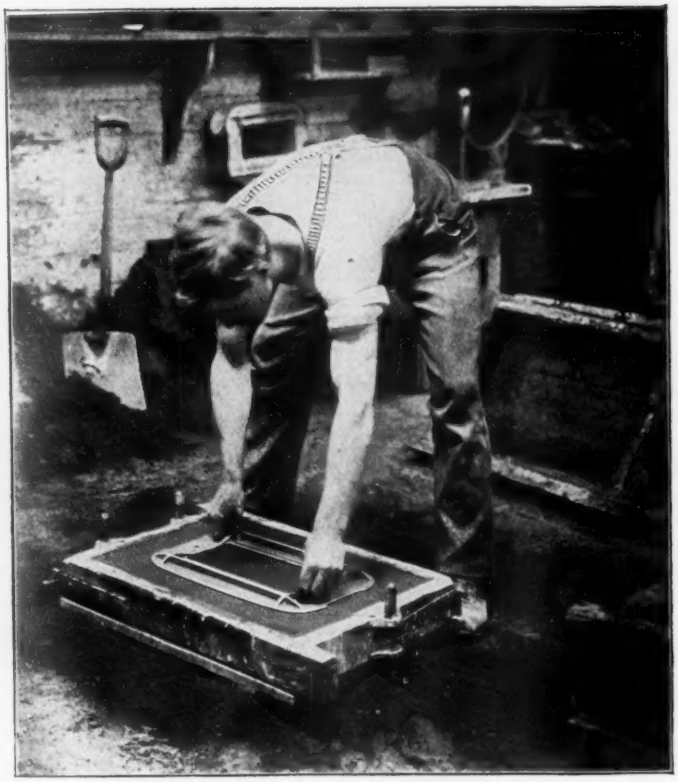

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Operated by
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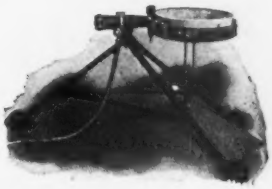
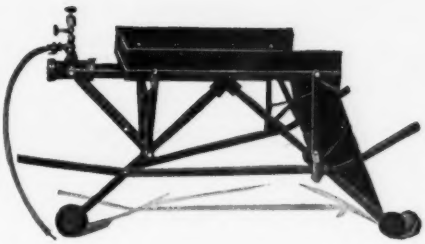


Will materially reduce the cost of the ordinary expensive manner of screening by hand.



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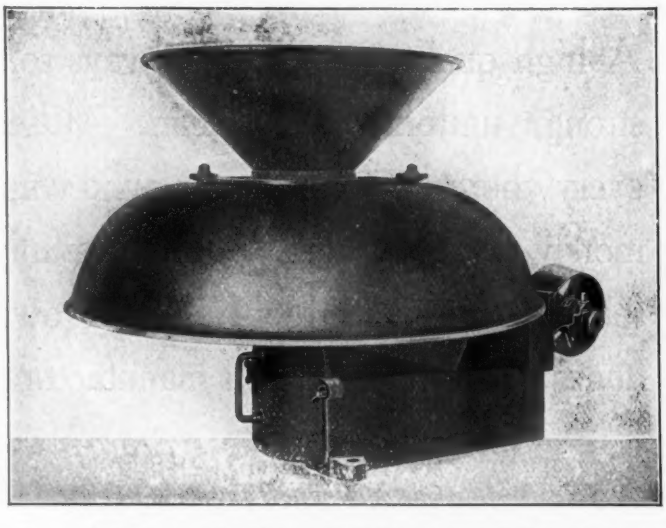

Centrifugal Sand Mixing Machine

We have furnished these machines to many users and shall be pleased to supply full particulars upon application.

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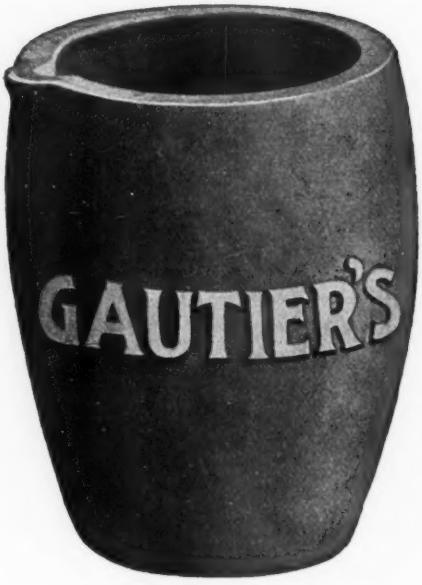

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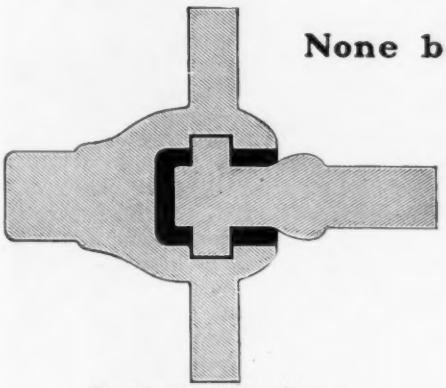
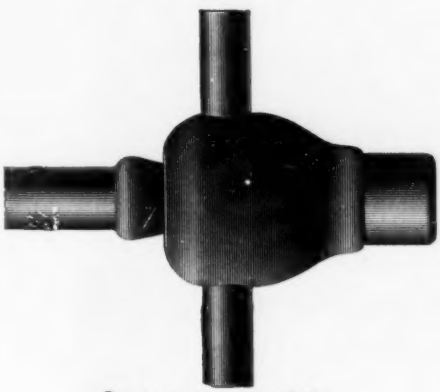


Sectional view of core.



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No broken cores.

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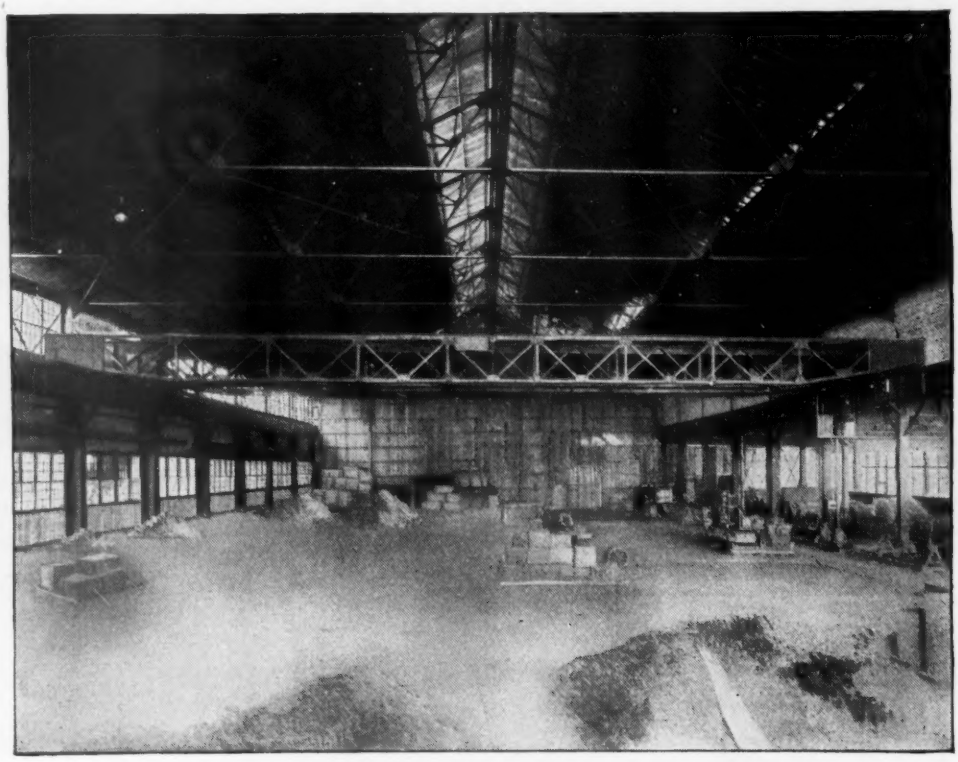

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THE FOUNDRY

Vol. 28, No. 1. *CLEVELAND, OHIO, MARCH, 1906.* *Whole No. 163*

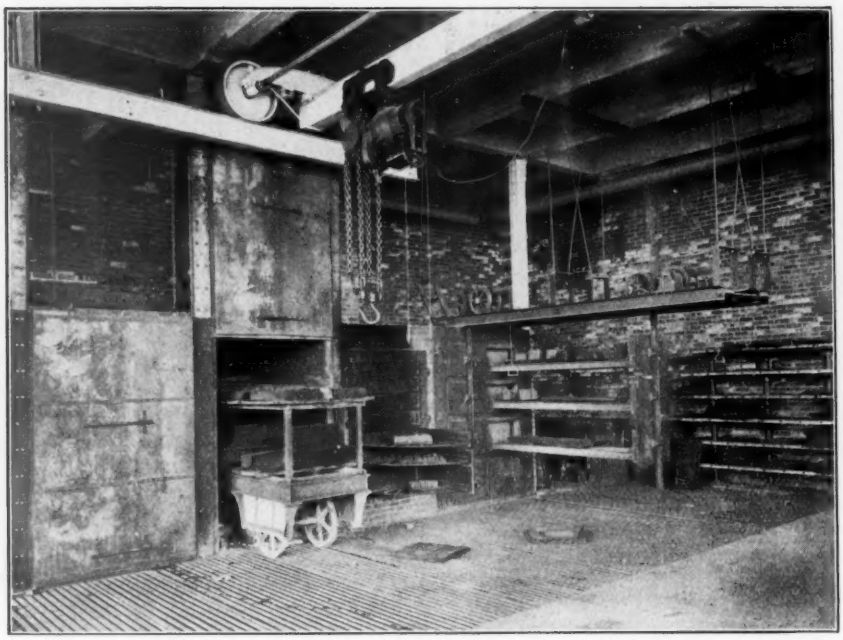
A Modern Machine Tool Co.'s Foundry Department

The Brown & Sharpe Mfg. Co., of Providence, R. I., is one of the best known machine tool manufacturing companies, not only in this country, but in the world. It has long been noted for its fine, high class machine tools and the castings required for these tools have always been the best that could be produced.

MAIN BAY OF HEAVY WORK FOUNDRY.

The arrangement of the foundry department in any plant must depend largely upon the output and the manner in which it is used. Where the output is composed mainly of very large and heavy castings, the foundry must necessarily be located on a railroad, so that the raw material may be brought in in large quantities and the castings loaded on the cars by the foundry cranes. But where the majority of the castings are comparatively small, few of them weighing over a thousand pounds, there are other factors which enter the problem, and we feel that the engineers in charge of the Brown & Sharpe Co. have analyzed the problem and balanced the different factors one against the other in a remarkably efficient manner.

In a foundry of this type the greatest saving can be accomplished by minimizing labor in the different departments and enabling the workmen to handle the material from department



SOME OVENS IN THE CORE DEPARTMENT.

to department with the least possible effort. Also the departments should be so planned that the finished castings move from the foundry through the cleaning department and to the manufacturing departments in the most direct manner and with the least amount of handling. This problem has been very well solved in the plant under consideration.

In view of all the factors mentioned the handling of the pig iron and coke to the foundry becomes rather a secondary problem and its handling for charging the cupola more important than its original delivery to the plant.

The company secured a plat of ground adjoining the works, one end of which rises in a fairly steep hill. This hill was graded into two benches and a series of concrete bins constructed along the face of the hill for the storage of molding sand, clay, seacoal, etc. These bins were illustrated in THE FOUNDRY November, 1902 during construction.

The top of the bins are arched over providing a very strong floor upon which the pig iron is stored on a level with the charging platform of the cupolas. Upon this floor the molding sand and other similar supplies are hauled in and dumped into the bins through openings in the roof of each bin. The wagons bringing the pig iron, molding sand, etc., enter from a side street along the driveway on the level of the top of the bins.

The coke for the cupolas is stored in a concrete bin built above and back of the molding sand bins; the bottom of the coke storage being on the level of the cupola charging platform.

The general foundry consists of the bin structure extending across the foundry department at the foot of the hill, from the front of which extend several parallel buildings, the first containing the heavy work foundry, the second building contains first the melting department with the cupolas, and second the core department, the third building contains the light work foundry and the fourth contains the cleaning department. These constitute the foundry proper. Adjoining the cleaning department, however, are two other buildings which are included in the

equipment. One is the power plant and the other the pattern storage building, on the first floor of which is situated the shipping room and on the second floor the wash room. The departments will be taken up in detail later.

Flask Storage.

For the storage of flasks and rigging most foundries make little or no provision and the material is simply piled in the foundry yards. The general plan of this foundry, however, includes provision for this class of material. Between the sand storage bins and the various foundry buildings there is a space of about 20 feet which is roofed over and spanned by a traveling crane. This permits the piling of cast iron flasks and rigging on about 12 feet of floor space between the buildings, this space being about 280 feet in length. A clear runway of about eight feet is maintained in front of the sand bins for the trucks used in carrying the supplies from the bins to the foundry.

The terrace upon which the coke bins stand on a level with the cupola charging platform has also been utilized for flask storage and is covered with a building. This provides a flask storage extending from the end of the coke bin

ONE OF THE CROSS BAYS.

over the balance of the storage bins. The accompanying illustration was taken at a time just after the completion of the bins and before the buildings mentioned had been erected. The space set aside for flask storage on this level is also covered with a traveling crane.

Melting Equipment.

The present melting equipment consists of three cupolas; two 48 inches inside of the lining and one 30 inches situated at the foot of the hill and to insure ample draft the stacks are made very high so that it is 100 feet from the bed to the top of the stack and 14 feet from the tuyeres to the charging door.

STORAGE BINS FOR SAND AND COKE.

Most of the material for charging is brought in on four wheeled trucks, the trucks being filled on the level of the top of the molding sand bins and wheeled across a bridge to the charging floor which is large enough to accommodate all of the trucks necessary for a heat. The pig iron is brought in on flat wheel trucks without any box or sides, while the finer scrap, coke, limestone, etc., are brought in either in two wheeled wheelbarrows or in four wheeled charging cars provided with drop sides. By this device one side of the car can be dropped down level with the bottom of the charging door so that the men do not have to lift the stock much during charging. The use of flat wheel trucks on a smooth floor permits of their arrangement in any way, and hence it is very much more flexible than any track arrangement could possibly be.

One exceedingly interesting point in connection with the melting equipment is the method of handling large ladles under the cupola spout. Beneath the cupola spout there is a pit in which operates a hydraulic platform elevator with a lift of about 4 feet. When a large ladle is to be filled the platform elevator is let down so as to form a pit of sufficient depth to permit of the plac-

CUPOLA CHARGING FLOOR.

ing of the ladle beneath the cupola spout. The platform can be instantly returned to its usual position after the large ladle has been filled.

Heavy Work Foundry.

This foundry consists of one bay, 34 feet wide running at right angles to the line of storage bins and a number of bays, 20 feet wide running at right angles to the main bay. The arrangement is very clearly shown in one of the illustrations. The heavy bay is equipped with one 10-ton traveling crane, and two five-ton electric jib cranes. Each of the side bays running at right angles to the main bay is provided with a five-ton electric crane. This makes the crane service of each of the small bays independent of the main bay as far as the handling of flasks, rigging, etc., in the bay is concerned. Each of the small cranes can run out under the main crane so that the latter can bring flasks, rigging, ladles of iron or any other equipment or supplies to the separate bays when the small cranes handle them to the desired location. The large crane is operated from a cage, while all of the small cranes are operated from the floor.

The foundry is provided with a concrete floor which permits of its being kept in very neat order and also facilitates the trucking of supplies, castings or equipment from place to place.

Between each of the side bays there is arranged a series of racks and shelves for the convenience of the molders, these shelves being used for the storage of patterns, tools, supplies, etc., which are needed in the work. In the main bay of the foundry several pits have been provided for use in the molding of large pieces.

Light Work Foundry.

This is situated in a building, 360 x 78 feet and separated from the heavy work foundry by the core department and the cupola room. The toilet rooms for the two departments are also situated between the two foundries. No traveling cranes are used in the light work foundry, but the trolley system is installed for the handling of flasks, rigging, iron, etc. This system is so arranged that the ladles during pouring off travel over the tracks in but one direction, and hence never interfere with each other. By a suitable system of switches and turnouts no ladle ever gets in such a position as to block the others. In this department some light floor molding is done but the majority of the work is put up either on molding machines or on benches. This foundry is also provided with a concrete floor. Both of the foundries, and in fact all of the buildings, are provided with an ample supply of north light, through suitably constructed skylights,

PICKLE BEDS IN THE CLEANING DEPARTMENT.

and also with a large supply of light through the side windows.

Core Department.

The core department is situated in a building between the heavy and light work foundries with a row of core ovens between the core department and the heavy work foundry. A few of these ovens are shown in one of the accompanying illustrations. These include a series of drawer ovens, a set of Millet ovens and several ovens provided with trucks. The row of ovens also contain several of the Brown & Sharpe ovens provided with shelves made up of hollow castings through which the products of combustion circulate. In fact, in most of the ovens the cores do not come in contact with the products of combustion.

The heavy cores are made under traveling cranes at one end of the department, loaded on the trucks and the trucks run into the ovens. The larger ovens are provided with doors at both front and back so that after the cores are dried the trucks may be pulled out into the heavy work foundry and the cores unloaded by a crane in the main bay of the foundry.

The core ovens are all fired from a pit which extends along the front of the battery of ovens and is covered with a grating. The coke is trucked in through the passage on the bottom of this pit and ashes trucked out in a similar manner. This does away with all handling of coke or ashes on the core room level and economizes space. The core sand and other supplies of this department are brought in from the storage bins and the sand all prepared by machinery.

Flask Department.

The flask department is located above the core department and on a level with the cupola charging platform. This department is equipped with machinery for making flasks and repairing patterns. The equipment consists of two combination cross cut and rip saws, two jointers, a grindstone, a 16-inch lathe, a 30-inch band saw and a number of benches. The lumber is also stored on this floor at the back end of the room. The elevator connecting this floor with the first floor of the plant is made long enough so that it can bring up 16-foot lumber without having to stand it on end.

Cleaning Department.

This department is situated in a building 340 x 40 feet. At the end nearest to the storage bins the heavy castings are cleaned. At this end the

building is divided into two parts by a line of columns running down the middle carrying the runways for two traveling cranes. Under one of the cranes is located the pickling department. This consists of two pickling beds, each sloping toward the common tank

PATTERN RACKS.

between the beds. The pickling solution is poured or sprayed over the castings and is returned by gravity to the storage tank situated beneath the floor. After the castings have been sufficiently pickled a small gutter or spout is introduced at the lower end of the bed so as to connect the bed with a large tank and water is then thrown over the castings from a hose and allowed to flow to the tank mentioned. The sand, scale and dirt removed from the castings are retained in this tank and are removed from there periodically. The water is allowed to escape to the sewer. There is also a tank for the dipping of small castings.

The large castings are chipped and cleaned under the traveling cranes at this end of the cleaning department. The far end of the cleaning department is equipped with benches, brushes and other necessary machinery for the cleaning of small castings.

Many of the small castings are also annealed and for treating these a battery of annealing furnaces of the well known Brown & Sharpe type are located in the building at one end of the cleaning department.

Pattern Storage Building.

This building contains on the first floor the offices for the pattern storage departments, shipping department, etc. The shipping room proper is divided into three parallel bays, each equipped with a traveling crane. Above the shipping room is located the wash room department. The floors of this room are all of concrete, and as the building is fire-proofed with concrete, every part of the room can be thoroughly washed. Each man is provided with an expanded metal locker which is supported upon iron feet raising it above the floor.

Between the rows of lockers there are benches for the convenience of the men when dressing and at the end of the lockers are situated the bath rooms. These are of unique design, each room is about 8 feet square and is provided with a slat floor in the center. Upon a bench at the back of the room stands a small galvanized tub into which the man draws the required amount of water of the proper temperature. He then washes using water as freely as he desires and the overflow is taken care of by gutters in the floor. Some men prefer this to a shower bath and it certainly has some advantages.

Above the wash room there are four floors devoted to pattern storage. These floors are about 7 feet 6 inches

LOCKER ROOM AND BATHS.

in height so that a man can reach any pattern without the use of a ladder. The style of shelving is shown very plainly in one of the accompanying illustrations and consists of a vertical pipe column onto which are clamped cast iron brackets supporting the pattern shelving.

FOUNDRY PRACTICE.[1]

BY WM. A. BOLE.[2]

My foundry experience has been confined to the making of engine castings, cylinders, flywheels, valves, and other such castings, both for steam engines and for gas engines, ranging in sizes from small to very large.

Castings of this class are very much machined; they are penetrated by the planer, lathe and drill press, and still they must be steam tight and gas tight after all this is done. Such castings are in distinction to many other classes, where a good, sound outward appearance suffices to obtain acceptance and where this inquisitorial work is unnecessary.

From my general relation to the manufacturing problem, I feel more interested in the ultimate sufficiency of a casting than in the first cost of making it.

It is, of course, common custom to make test specimens attached to, or poured from, the same metal as our large castings, and we are obliged to place reliance upon such test pieces, as they are perhaps the best method of obtaining knowledge which we can employ, but we all know that test bars alone are no sufficient assurance against treacherous castings, and that they do not pretend to reveal such dangers as internal strains in complicated castings, which often have far more to do with the value of the casting than has the quality of iron out of which the casting was poured.

It is of great importance for any man to have a certain repetitive experience which we call specialization, and it is almost equally important to have a fair fund of collateral knowledge in order to supplement the first sort. This will increase his reasoning powers and make him a more active student of cause and effect. The foundryman can very well afford to know some other things besides the daily round of his duties, and I believe that foundrymen nowadays are, as a rule, inquisitive, studious men, who are doing their best to increase their fund of knowledge. Not all men are built this way, however; I remember once having a very competent machinist ask me if wrought iron was made out of cast iron, or if cast iron was made out of wrought iron, and how it was done.

The present day aids to the foundryman are much greater and more extensive than they were some years ago. Engineers are paying closer attention to foundry methods, assisting the foundryman where they are able to do so, and tending to make his work easier and more sure. Formerly there seemed to be a distaste for foundry details, and many a design has been made where the engineer in charge spent much time and labor in going over his drawings, his engineering calculations, and his preliminary estimates, but as for the carrying out of the foundry work, depended wholely and absolutely upon the empirical experience of his foundry foreman, trusting entirely to the judgment of the latter for every move in the carrying out of the work, never going near the foundry himself.

I think too that the advent of the steel casting has had something to do with this change; it has always seemed to me that people engaged in the steel business have been a sort of a brotherhood, willing and anxious to exchange views and to help the other fellow out of a tight place, and this spirit, added to the additional field for the use of the reasoning powers, has tended to make the iron foundry business less of a sealed book than formerly.

There is no possible doubt as to the value of discussions in regard to foundry matters by people who have any experience with the subject, and we, all of us, ought to be of a mind open to conviction and without too much heed for consistency with our past views.

In the conduct of the iron foundry of which I have had charge for some years, I have endeavored to induce as much reasoning and thinking among the foremen as possible, and in order to have some nucleus, or nest egg, around which to gather reflections, I prepared a little treatise some years ago

[1]Abstract of a paper read before the Pittsburg Foundrymen's Association, Feb. 5, 1906.

[2]Manager of Works, Westinghouse Machine Co.

which I called our "foundry primer," being written by an infant for the use of the infant class, and liable to contain some infantile ideas; however, even an infant's mind is better than no mind at all, and it is possible that such a mind may develop into that of a grown adult, and I propose to read to you some extracts for your consideration.

Notes on Foundry Practice.

The following memorandum is intended solely for our own foundry foremen, and is issued with the knowledge that it may be in contradiction to some of your opinions on the subject, in order that such points may be discussed and combatted in the general interest of finally arriving at definite conclusions in regard to foundry practice.

It is more or less beyond dispute that for every sort of defect in iron castings, more than one opinion can be advanced as to the reason, and in complicated cases there are likely to be as many reasons as there are persons. There are many circumstances which can conspire to produce bad results in foundry practice, and there is practically only one way to produce good results, which is by having every feature of our practice perfected. The difference between what will produce a good casting, and what has produced a bad one, is often small, and it is therefore important that no consideration connected with molding or pouring castings should be considered too small to be worthy of the foundryman's consideration.

For the benefit of our own organization, and for no other purpose, the following memorandum is issued:

Use of Scrap.

It is the writer's belief that almost any pig iron is improved by remelting, especially if its sulphur content is low in the first instance. Raw pig iron is likely to be very high in carbon. There are two forms which carbon may assume in iron castings, namely: the graphitic form, in which the carbon separates out from the iron into large flakes like plumbago, and which have the effect of separating the particles of the metal, insulating them from each other, and tending to make the iron soft and weak. The effect of remelting the iron is to reduce the amount of this graphitic carbon. When iron is melted and in the ladle, the carbon in the iron assumes the form of combined carbon, otherwise if it remained in the graphitic form it would float off on top of the iron as slag, being very much lighter than the iron itself. In the act of cooling part of this carbon remains in combination with the iron, and is known then as combined carbon, tending to make the iron hard and white, while the larger portion of it goes back into the graphitic stage, with which appearance you are familiar. The principal difference between iron and steel lies in the fact that steel contains no graphitic carbon, and a rather high percentage of combined carbon, depending upon the purpose for which the steel is intended. It is really the presence of graphitic carbon which makes the pig iron to be iron instead of steel. In an open-hearth steel melting furnace the carbon is burned out, and the iron changes from pig iron into steel. Therefore, each remelting of the pig iron, if it could be done with a fuel containing no sulphur, would be one step toward making steel out of your cast iron.

This tendency of the carbon to become graphitic is useful for some purposes and harmful for others. In fact it might be fair to state that there is no such thing, properly speaking, as impurities in iron,—the sulphur, phosphorus, manganese and silicon, bear about the same relation to pig iron that pepper, salt, mustard and vinegar do to the food we daily eat. Each one of these elements has a certain effect upon the iron, and rightly employed they do good instead of harm. They must, of course, be controlled or there will be bad results, just as though too much salt had been employed in an otherwise very nourishing and palatable dish of food. The tendency of graphitic carbon to form while the iron is cooling makes thin castings soft where otherwise they might be too hard to

machine, and if very thin castings are to be poured, such as novelty work and the like, it might be said that the iron could not be too high in graphitic carbon. If this same iron, however, were poured into thick and heavy sections, the result would be carbon flakes so large and so separating the grains of iron one from another, as to make the iron soft and weak, with a tendency to be porous and spongy in the center and unsuitable for any such work as engine work. The remelting of the iron tends to reduce this graphitic carbon and therefore scrap, being remelted iron, is profitably employed where the castings are thick and heavy, in order to close up the grain of the iron and make the metal solid and strong, even where it is quite thick in section. This is equivalent to saying that scrap should be used more carefully and sparingly in thin castings, and used freely and in considerable quantity for large and heavy work, the only danger in the case being that each remelting of the iron is likely to increase the sulphur content. It is not always safe to use too much scrap of unknown character, lest the sulphur run too high. In cases where the castings must be particularly clean, close grained and hard, as for instance, cylinders for steam and gas engines, it will be advantageous to use a very considerable quantity of scrap, and if the gates and sprues and pig bed of the previous heats can be collected and saved for this purpose, the results will be better than though any raw pig is employed. This use of scrap iron should be employed rather to improve the quality of the iron than to simply cheapen the cost. If this improvement in quality is constantly kept in mind, it will lead to scrutinizing the scrap to reject any pieces which are obviously unfit to use, such as burned iron found in grate bars, annealing boxes and the like; all bolts, nuts, or other wrought iron or steel pieces, should be picked out of the scrap pile and not allowed to enter the cupola or air furnace.

Requirements of Castings.

Before any statement can be made in regard to the proper iron to use, the foundryman must know what is the character of the casting which is to be made. Probably no question is more vital than the question of size, that is, its thickness as affecting its rate of cooling. It is an absolute impossibility to find any one iron which is suitable at the same time for very heavy and very light work, and to employ metal from the same ladle with which to pour a casting whose average thickness is 2 inches, and another casting whose average thickness is ¼ inch, is a foundry absurdity, and should be so considered and recognized by the man in charge. The iron which will make the large casting close, solid, strong and reliable, will make the small casting hard and flinty and impossible to machine.

Conversely, the iron which will make the small casting soft and suitable for its purpose, will be likely to make the large casting open, spongy, weak, and with great tendency to shrink in the thick spots, and in general produce bad work. Therefore, the difficulty of running a general foundry, in which both light and heavy work are to be cast on the same day, and out of the same cupola, is very considerable. If the foundryman has nothing but light work to cast, he should use irons which are low in sulphur, fairly high in phosphorus, and high in silicon. These qualities will give him softness, and at the same time sufficient strength for almost all ordinary purposes.

If, on the other hand, the foundryman is making only large and heavy work, where soundness and strength is demanded, he must necessarily employ an iron harder in its quality, and this is to be produced by using metal comparatively low in silicon, lower in phosphorus, and may contain considerably more sulphur than would be permissible in the light castings. This is one of the reasons why foundries running on specialties, have much better results with their castings than general foundries making, or attempting to make,

both classes of work. We should, as far as possible, use a different cupola for our light and medium work which we wish to come soft, from that employed for our large and weighty pieces, which require a different metal to be charged in order to meet their peculiar requirements.

Of course the cupola as a melting furnace is capable of being charged with different grades of metal, which may be tapped in the sequence in which it is charged, and a fair approximation may be had to what is wanted, provided the foundry foreman is very careful to stipulate just what he wants charged, and in the proper order, and provided also he taps and and pours this metal in the precise order which he had intended when making up the cupola charge. It is probable, however, that the metals do not all melt in precisely the order in which they are piled in the cupola and certain of the irons may melt too early or too late to take their proper place in the procession of events. In case special iron, either light or heavy, but different from the average iron of the heat, is desired, it is best to charge such special iron on the first coke bed, and pour it off before the general run of the mix is tapped.

If this statement of the difference between requirements for large and small castings is true, it involves a careful separation of such parts and a careful planning on the part of the foundryman as to the order in which his molds will be ready to pour, so that he may put the iron intended into the mold intended, and not get the wrong iron into the wrong mold. Cupola melted iron is likely to be not thoroughly well mixed, and as an illustration, two or three irons might be melted in the same charge, and might be tapped out into the same ladle, but for want of stirring might be in the same condition as milk newly poured into coffee, that is, there might be a stratification of the various metals, and as the coffee is stirred up with a spoon, so it might be well to stir the iron up vigorously to produce a uniformity and amalgamation of the ingredients which would tend to better results. For important work it is apparent that melting iron in the air furnace is superior to the practice of melting it in the cupola. In the air furnace the iron can be rabbled or stirred, and thus made to thoroughly intermingle, and, in addition to this, the tendency to boil itself, produces a stirring and intermingling of the ingredients, which always results in a stronger and more homogeneous iron. This rabbling, however, should not be done with steel or wrought iron bars, as is often the case. These bars will sluff off, and the wrought iron, having a much higher melting point than the cast iron, will not thoroughly mix with the latter, but is likely to be carried along simply in suspension, or as slag would be carried on the top of the iron, except that in this instance it probably floats with the metal, being of about the same density. It occurs to the writer that the spotted and mottled appearance of many finished castings is due to the fact that a scum of wrought iron from such cause as this has lodged against the wall of the mold and in the finishing has revealed its presence by its different color.

It would seem to be safer practice to rabble or stir the molten metal in the air furnace by the use of wooden poles or saplings, and these latter, in addition to acting as stirring rods, produce a boiling by the sap or moisture within them, and this boiling gives the iron a chance to thoroughly mix and mingle, and possibly to rid itself of any contained impurities by the agitation.

It would be impossible to use just this same method in cupola melting, but to hold a hickory pole in a ladle of iron being tapped from the cupola ought to produce something of the same results, and the boiling in the ladle would tend not only to stir it well, but to throw off contained gases by bringing them to the surface. The use of small quantities of aluminum, about one pound of aluminum to the ton of iron, has been recommended as a means of producing this same sort of searching out of molten iron. It is alleged that the aluminum has a strong

affinity for any contained oxygen in the molten metal,—this oxygen being present in the form of burned iron as the foundryman recognizes it. It is well known to all foundrymen that burned grate bars, and other such iron, when charged into the cupola, are the source of a great deal of trouble, and that while such impurities create a great amount of slag, it is to be feared that part of the evil is taken up by the iron itself, although it may seem to be comparatively clean and free. The aluminum is alleged to have the property of eliminating such contained oxygen, making the castings sounder and more solid. The aluminum is very light and would float on the surface of the metal; it is, therefore, preferable to hold it below the surface of the metal in some way, and allow it to diffuse itself throughout the entire ladle.

In general, it is probably safe to say that cast iron does not permit of softness and strength in the same iron; that softness in cast iron is always accompanied by weakness, and that strength in cast iron is always accompanied by hardness, unless the iron should be so hard as to be chilled in thin sections, and then it becomes brittle and weak from its chilled state.

The following is a table submitted as a statement of opinion of the relation which should exist between the thickness of metal in the body of a casting and the chemical composition of the iron out of which it should be poured:

Size.	Silicon.	Phosphorus.	Manganese.	Sulphur.
¼ in.	3.25	1.00	.40	.025
½ in.	2.75	.80	.40	.040
¾ in.	2.50	.75	.50	.050
1 in.	2.00	.70	.60	.060
1½ in.	1.75	.65	.70	.070
2 in.	1.50	.60	.80	.080
2½ in.	1.25	.55	.90	.090
3 in.	1.00	.50	1.00	.100

It is, of course, understood, that this is intended to apply only to our own local practice and to nothing else.

In the case of very small castings, if we calculated their thickness on the basis of the strength of the iron, they would be so thin that the foundry would be taxed to produce them, and generally speaking, small castings are made thicker than considerations of strength demand, simply because this action complies with the foundry requirements better. In the case of very large machinery, however, it is different, and when cylinder walls and other thicknesses run up to 2 inches and 2½ inches, it is because the strength in such castings is demanded by the strain upon them, and it is somewhat unfortunate in fact that these large castings of thick section, by virtue of their slower cooling, cystallize into a larger structure in the act of cooling and are not inherently as strong as they would be if poured into lighter molds. Therefore, while it is important in the light work to select iron which is sure to be soft, it is just as important, if not more so, in the large work to select iron which is sure to be strong.

For your benefit the following analyses of various pig irons which we are now employing, are presented, in order that in the light of the foregoing, you might be able to pick out what pig iron should be employed for making your large and heavy castings, and what should be employed for making your thin and light castings. It must be understood, however, that no single analysis can be depended upon for any given brand of iron,—that the irons are liable to vary, due to changes of the quality of ore, or the quality of coke at the blast furnace, and these variations might be produced by as simple a thing as a dry season in the coke regions, compelling the use of sulphurous water in quenching the coke.

	Silicon	Manganese	Phosphorus	Sulphur
Hecla	1.61	1.27	.23	.061
Mannie (Charcoal)	4.36	.51	2.16	.073
Isabella	3.09	1.09	.745	.028
Clinton	1.81	1.29	.512	.013
Ella	1.24	.45	.251	.044
Olive	1.38	.59	.874	.156
Pioneer	2.09	.56	.68	.048
Mabel	.98	.40	.122	.034
Emporia	3.29	.63	.804	.010
Tonawanda	1.62	.31	.628	.066
Bellefonte	2.21	.39	.66	.079
Punxsutawney	1.22	.49	.64	.022
Ella	1.08	.43	.246	.070
Cherry Valley	2.21	.61	.941	.066
Hinkle (Charcoal)	1.36	.31	.136	.019
Mary, No. 3	1.17	.77	.325	.031
Seneca, No. 2	2.39	.41	.277	.009
Seneca, No. 3	1.41	.46	.237	.028
Embreyville	2.87-1.59	.82	.278	.089

Every carload of metal should be analyzed, and the selecting of the specimens from every car should be carefully done, and as far as possible, always by the same man, in order to insure of his getting a

uniform specimen of each carload. The iron should be tested for hardness and tendency to chill by casting a sample piece against a cold metal chill and always with a uniform speed of pouring, so as to avoid accidental differences calculated to offset the accuracy of such determinations. The iron should also be tested for strength daily by making cross breaking specimens one inch square, about 14 inches long, which shall be broken on knife edges set 12 inches apart, with the breaking weight applied at the center. By daily comparison between the analyses of the iron charged and compared with the depth of chill and strength of test specimen, as well as analysis of the casting, a careful co-operation between the chemist on the cupola platform and the foundryman on the foundry floor, should produce good results. Neither one of these men can do the business alone or without the co-operation and assistance of the other. If the foundry foreman shall pour the iron intended for thick castings into thin molds, he will produce bad results, and in such case should not attempt to hold the chemical treatment as responsible.

Bad Castings.

If the casting is bad, it may be for any one of several reasons. If it cracks in the cooling, it may be due to the quality of the metal out of which it was poured, or it may be due to the haste with which it was uncovered and exposed to the cold air in cooling. The iron which will make a good casting when slowly cooled, may make a cracked casting if the latter is pulled out of the sand too quickly, and since in our practice we are in the habit of unusual speed in pulling red hot castings out of the sand, it is particularly important that iron should be free from shrinkage tendencies, and therefore should be low in sulphur. It is unquestionably good practice to allow the castings to remain in the sand as long as possible, and if circumstances permit, until they are perfectly cold. Certain castings having unsymmetrical proportions may be aided in the act of cooling by exposing the thick places first, as for instance, in the case of a heavy flywheel with a set of light arms, it will be advantageous to expose the outer portion of the rim and cause the rim to cool and contract more rapidly than otherwise and more nearly in time with the thinner arms.

Certain castings, by virtue of their intended use, are much more critical than others, and the iron which might be good enough for bedplates or engine housings, which do not receive much finish, and which may be cast with the critical side downward, may not be sufficiently good iron for cylinders, in which there is a great amount of finished surface, and which a comparatively small defect will cause to be rejected.

In the case of dirty castings, it may often be the case that the manner of cutting the gates is responsible for the dirtiness. The iron may enter the mold in such a way as to wash away part of the sand mold and the sand thus liberated may fuse with the iron, forming a pasty, sticky mass, and may defy the rules of gravity and not swim to the top of the mold, but adhere to the mold wall tenaciously and allow the molten metal to surround it and pass on over it. This will result in a sandy, spongy spot, which may condemn a large and valuable casting.

It is of the utmost importance, therefore, that the foundry foreman should supervise the method and manner of cutting the gates, and not allow this to be done at the whim of the individual workman. The runner, or entry, by which the metal finds its way into the mold, is exposed to far more severe service than the body of the mold proper. In the case of a large casting it may be that 20 or 30 tons of metal is compelled to run through a narrow passage, something like a hose, and this iron, being fresh from the furnace, and intensely hot, will fuse the sand on the walls of the runner or intake, and if the sand thus fuses, it will form a glassy, pasty composition, which may be dragged along by the stream of metal to lodge some place in the mold, and generally in an important and cri-

tical place. It is, therefore, of great importance that the runner or intake should be formed out of the very best sand obtainable, and carefully dried and protected by the best of facing, in order to prevent this action. For such facing, plumbago or graphite is used, because it is almost infusible by heat, being one of the most difficult materials to melt known to man. If pure plumbago is used as a facing, preferably by swabbing it on in liquid form and then drying, this makes a non-conducting covering, so to speak, protecting the sand against the heat of the iron. For pouring large and critical castings, such as cylinders, we advocate the use of fire-brick runners, in order to prevent the sand from being thus acted upon at this most critical point in the whole mold;—a good fire-brick having a higher resisting power against heat than molding sand,—and if they are protected by a good coating of plumbago facing, they will endure a vast amount of liquid metal pouring over them without giving away to it. It is a universal practice in the making of steel castings, in which the molten metal is very much hotter than any iron foundry ever experiences, to use special clay runner pipes made especially for this purpose, and for the particular reason that the sand out of which the molds are prepared, is not good enough to stand the onrush of the fresh liquid metal. We have in our own experience evidence to prove the value of making the runners in this very careful way.

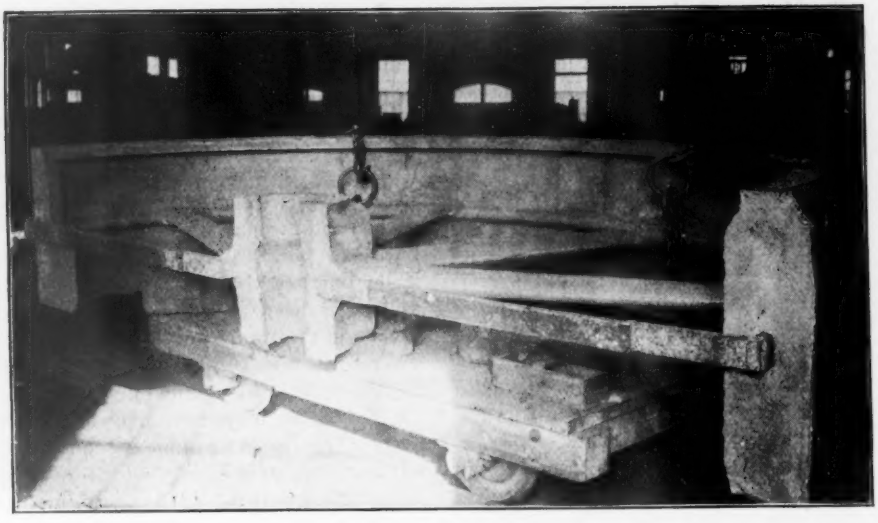
As the iron is rising up in the mold, such molds being usually poured from below, the walls of the mold are not exposed to the same furious action as the walls of the runner. The iron does not pass them with the same velocity, and is not of the same intense temperature by the time it reaches the mold proper, and therefore the wall of the runner gets more severe service than the walls of the mold.

There are a great many castings which have what is commonly known as a clean side and a dirty side, that is to say, one side is particular and the other one is not so much so. In consequence, the molder who makes such castings may succeed in making a large number of passable and acceptable castings, and get into the habit of doing work in a certain way calculated to produce results "good enough" for that class of work. The same molder may be taken from such a job and put upon another piece of work which must be clean both in cope and drag, and if he pursues the same line of policy as he has been accustomed to, he may turn out nothing but bad castings. Therefore, it follows that a man skilled in making some one particular kind of work, may, by happy combination of processes, produce good work without really knowing which of the many things involved is accountable for his good results, and he may be put on another job no more critical than the first job, but requiring a little different line of thought, and he may produce bad work.

There are probably few departments of manufacturing in which there is as much chance work and as little absolute and positive knowledge as in the making of iron castings. This will account for the various opinions which are advanced by various experts, each equally competent in his own line, and yet radically differing from each other in his views.

Flasks and Outfit.

The making of large and important iron castings ought to be attempted only after consultation between the foundry foreman who is to prepare the mold, the pattern maker who is to make the pattern, and the mechanical engineer, who ought to be employed to compute the stresses and pressures involved in the pouring of liquid iron, in order to make the rig strong enough without making it excessively weighty and costly. The pattern maker should not attempt to proceed with the making of the pattern until he has consulted with the foundryman who is to do the molding, in order that the pattern may be built on such a plan as to assist the foundryman in his mode of molding. This involves that the pattern maker must know a large amount of details of the foundry in order to co-



ONE-HALF OF WHEEL AS IT CAME FROM THE MOLD.

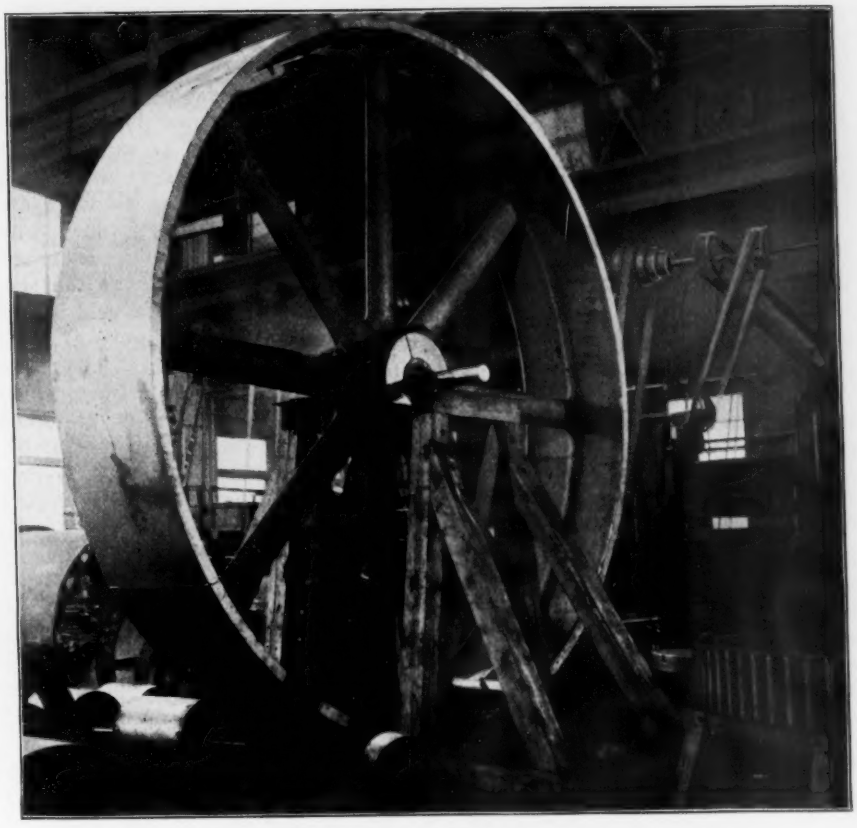
operate to the best advantage, and the foundryman on the other hand would do well to know something of the art of pattern making, in order that he may not ask for conditions which are antagonistic to good practice in that department.

Patterns must be made to be strong and durable, and free from tendencies to warp and twist out of shape. The pattern maker should be the best judge as to how to construct his pattern and core boxes to take care of this consideration, and it is obvious that each department having certain points it would wish to press, must be willing to give way to good and sufficient reasons on the part of the other. The pressures produced by liquid metal in the molds, and the resulting strains on the parts of the mold, are often tremendous, and they are generally too intricate to be readily calculated by the molder or foundry foreman, because such calculations are more or less out of his line. Therefore, in the designing of flasks and rigging, the work of the mechanical engineer, trained along such lines as this, qualifies him to design bracing, clamping, and other means of strength, to a better and more effective degree than could be done by either the foundry foreman or the pattern maker.

It is, therefore, apparent that a deliberate and judicious consultation among the three such officials should result in the best outfits, and as the security and safety of large molds may depend upon the correct knowledge of the strains involved, and of the strength of parts required, the subject should be viewed from all sides before any move is attempted.

Generally speaking, the foundry foreman and the patternmaker should determine the question of methods of molding, and the engineer should take up the matter at this point and compute thickness of plates, flask walls, bolts, clamps, holding down weights, and other mechanical details, as his training would best qualify him, and such rigging when judiciously made will shorten the work of molding, increase the safety of molding, and insure a perfection of the finished product in a way that should be gratifying to all parties concerned.

If a foundry foreman has due appreciation, therefore, of the requirements of his different classes of work as to metals necessary to produce the best results, if furnished with the metals of suitable qualities for the purpose intended,



WHEEL ON BALANCING HORSES.

and pours these metals at proper temperatures, into molds which are properly made and properly braced, and made of the most suitable quality of sand, protected by the best facing, the finished result ought to be a good casting, and one which we may be proud of.

CASTING ONE-HALF OF A WHEEL.

The duplication of a small casting is not a serious problem, nor does the ordinary foundry hesitate to take a contract for the production of a large casting of specified size, but to produce one-half of a casting to replace a broken piece is a more serious problem. The H. W. Caldwell & Son Co., of Chicago, has recently taken a contract along this line, and fulfilled it remarkably well. A large band wheel, or fly wheel had been cast, and finished up for an engine. While the engine was being erected, one of the halves was accidently dropped into the pit and broken. The wheel was of the planed joint type, so that the halves had been cast as separate pieces. Drillings were first secured from the half wheel, which was still intact, analyzed, and a mixture calculated which would give the same shrinkage as that possessed by the iron in the uninjured half. The mold was then made in loam, with the hub and arms in cores in the usual way. One of the accompanying illustrations shows the casting in the cleaning department, just as it came from the mold. The new half was first planed and drilled, after which it was bolted to the old half, the parts placed on a 20-foot boring mold, and the new portion turned up and bored out to correspond to the old portion. The wheel was then placed on the balancing horses, as shown in the other illustration. The remarkable part of the whole job is that while the wheel was 18 feet in diameter with a 42-inch face and a 15-inch bore, and weighed 27,806 pounds, it was only

94 pounds out of balance. The new half being 94 pounds lighter than the old half.

OPEN-HEARTH STEEL CASTINGS.

BY W. M. CARR.

Acid Furnace Brick Work.

The furnace body wherever subjected to uniform, high temperature is lined by first grade silica bricks. Piers and outside walls of structure below charging floor can be red brick; linings of flues and chambers including checkers are No. 1 fire brick. Silica brick will not answer for checkers because they will crumble under the varying ranges of heat.

The hearth pan is lined with fire brick to the depth of nine inches or more, but above metal line of fully lined hearth, the sides, walls and roof are silica. With the brick work complete the furnace is first dried moderately and carefully with a wood or soft coal fire kept going for a few days.

The gas or oil can then be turned on slightly at first and then gradually raised to nearly full working temperature. Layers of silica sand of the quality described in preceding chapters are then spread over the bottom. They are put in in succession and between each interval the flame is allowed to set or sinter the sand until hard. This operation is repeated until the hearth lining will have reached a depth of 18-20" including the fire bricks. A hearth so lined with a suitable refractory ought to last almost indefinitely under favorable conditions.

There will be occasional patching of slag line and bottom, with sand at the end of each heat, the extent of which will be controlled by the conditions and character of stock used in melting. A hearth properly lined must be set hard enough to resist attrition by the charging of melting stock. Under skillful handling an acid furnace ought to turn out normally 950 heats or more in a campaign at the rate of at least 3 heats per working day.

Basic Furnace Brick Work.

The designation basic is rather a misnomer. The nature of the basic process requires a lining of such materials that will resist the fluxing action of limey slags and vapors necessary to purify and refine phosphoric melting stock. Unfortunately no materials are commercially available to completely line a furnace body, so recourse can only be had to a hearth lined with basic materials, with roof, sides and walls of furnace body above the slag line consisting of silica or acid bricks, the reasons being that bricks of basic or neutral material, such as magnesite or chrome, while being refractory, do not give as good results as silica bricks, owing to a liability to crumble if placed in walls or roof. Therefore a basic furnace is part acid and part basic lining.

With the exception of furnace body in regard to brick work, the construction is the same as an acid furnace. The hearth pan is first lined with fire brick followed with magnesite bricks. Usually the bottom is lined with ground magnesite. It may be mixed with about 5 per cent of anyhdrous tan and rammed in to form the hearth and then slowly and carefully brought to full temperature; or the magnesite may be put in loosely in layers and gradually sintered. A small percentage of ground basic slag is sometimes mixed with it to insure a partial fusing or sinter.

A magnesite hearth while costly gives the best results in service and will sinter hard enough to withstand rough usage by charging of stock. Where the magnesite bricks meet the silica bricks of the walls, a parting of chrome ore is placed as a neutral separation of the two to prevent a fluxing liable to ensue between them at full working temperature.

There will always be some scorification of hearth at slag line and an occasional formation of holes in the bottom, due to the action of silicious matter carried in with the stock. The repairs to hearth are made with raw dolomite on slag line, and with ground magnesite on the bottom. Dolomite being so much cheaper it is fully as effective as magesite at slag line. In the raw state it is not recommended

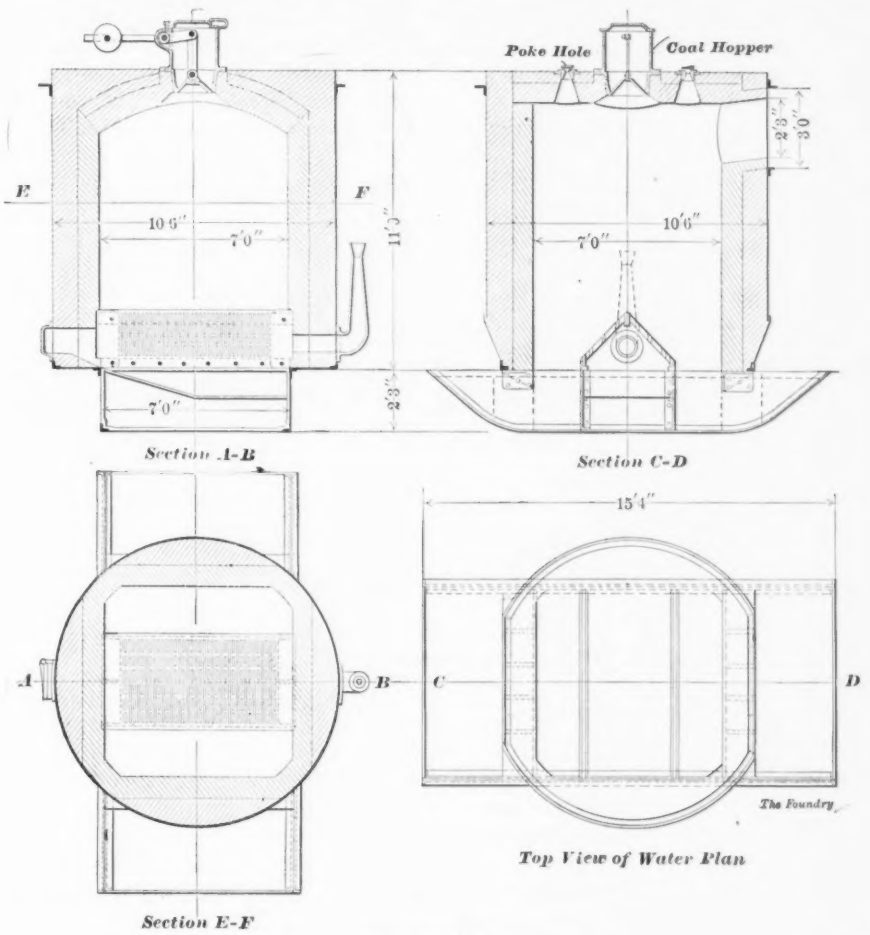
for bottom repairs, because at a high temperature it is calcined, contracting greatly in bulk and for that reason holes in the bottom cannot be satisfactorily filled with it. Under the heat of fused stock it would loosen, float upwards, and leave the condition as bad as before the patch.

Undue hearth scorification can be controlled by proper care in character of stock. Hence the consumption of refractories for hearth patching can be kept at the minimum figure. With proper care a basic hearth of magnesite should last indefinitely, and the life of the brick work of roof and walls ought to yield 400 or more heats at 3 heats per day.

Fuel Accessories.

As the choice of fuel may rest between producer gas or oil, a description of the operation of either will be briefly considered. Referring to the cut of a gas producer a general idea will be formed of its construction. The one shown is of the simpler kind and entirely hand fed and poked. In some of the large rolling mills coal is fed in continuously by a mechanical device, and the bed of fuel is poked by a mechanical contrivance. The principle of operation is the same in either case so far as making gas goes.

For a continuous supply of gas, air and steam are forced through an incandescent bed of bituminous coal on



GAS PRODUCER.

top of which is fed at regular intervals fresh coal. Frequently the mass is poked with long bars to break up the decomposing coal and to prevent holes or passages being formed which might allow air to pass through them and dilute the gas. In the vicinity of the grate, which is water sealed, the fuel is completely burned, while that near the top gives off its volatile matter, forming copious volumes of smoke with some tarry matter. As the fuel descends towards the grate it is gradually burned to ash.

For proper working conditions the bed of coal should be kept at a constant height, and vigorous poking should be frequently and persistently followed.

The object of water-sealing the grate is to permit the amount of air necessary to gasify the coal, to be under control at all times.

The use of steam lessens the temperature of combustion at the grate and so lengthens the life of the grate bars, at the same time the steam chemically combines with the fuel to form water gas as will be shown. It also prevents the formation of clinkers making it easier to keep the fires clean.

To make good gas the fuel must be hot, and close attention must be given to the admixture of air and steam forced into the producer. Too much steam tends to cool the fires and pass into the flues, undecomposed, causing an extravagant loss of fuel efficiency. A deep, hot bed of coal will yield the richest gas.

It will not be amiss to consider some of the chemical changes that take place in a producer. Roughly the bed of fuel in it can be divided into two zones. The lower one, nearest the grate, can be called the CO_2 zone and the upper one the CO zone. The air coming into union with the fuel near the grate forms.

$$C + 2\,O. = CO_2.$$

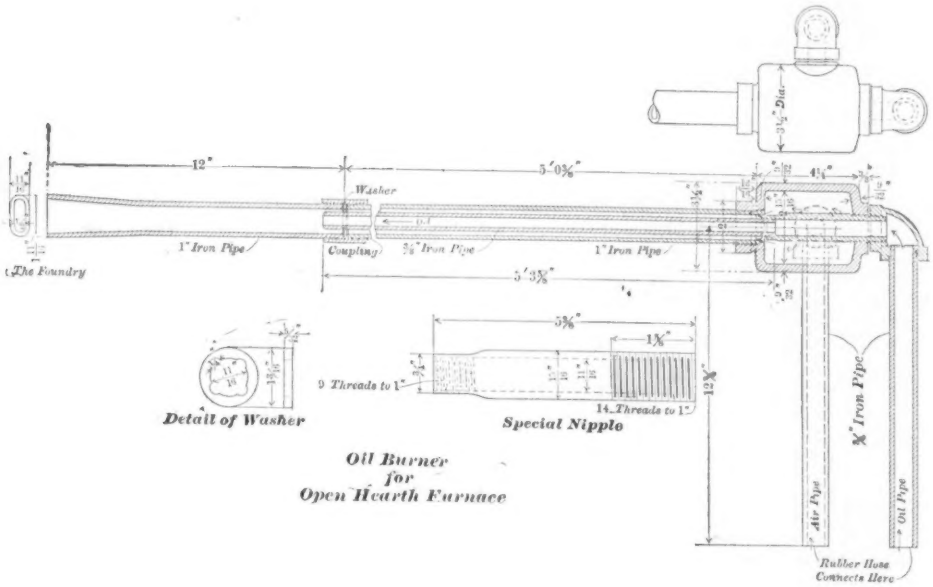
CO_2 is of course, non-combustible but as it passes upwards it combines with the glowing carbon of the CO zone and absorbing some becomes

$$CO_2 + C = 2CO.$$

the latter constituent forming the larger volume and chief calorific agent of producer gas. By the action of steam we have

$$C + H_2O = CO + 2\,H \text{ (water gas)}$$

The calorific value of this last product is greater in equal volume than the CO formed in second equation but at the expense of the heat in the bed



of fuel. The following is an analysis of producer gas.

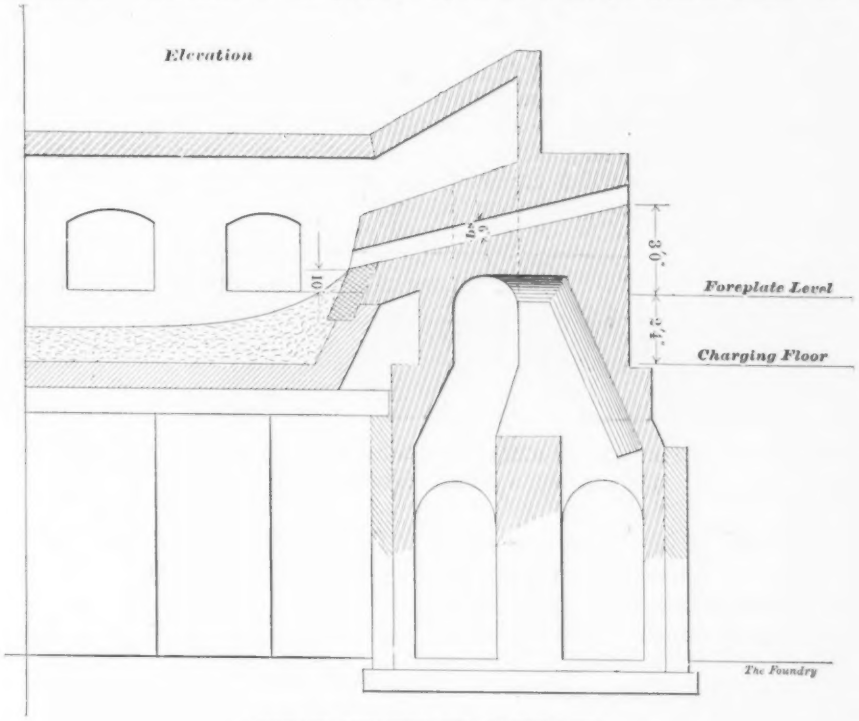
C O	27.00 per cent	by volume
C O_2	5.00 per cent	by volume
H	10.00 per cent	by volume
C H_4 + C_2 H_4	1.50 per cent	by volume
O + N by diff	56.50 per cent	by volume
	100.00 per cent.	by volume.

The amount of oxygen in the gas will be about 1 per cent, and represents the air that passes through the producer uncombined. The index to the proper working of the producer is the amount of CO_2 present. Under the most advantageous conditions it will rarely fall below 2.5 per cent and with bad conditions it will exceed the average of 5 per cent. The causes of an excess are due to insufficient poking, a shallow fire and faulty brick work allowing air leakages to ignite the gas before it can be delivered to the furnace.

At the best, producer gas is unsatisfactory, and the steel melter is always at the mercy of the vigilance or lack of it, of the gas man.

One ton of bituminous coal yields 160,000 to 170,000 cubic feet of gas with a calorific value, at the producer, of about 137 B. T. U. per cubic foot. The gas in traveling to the furnace looses heat units at a variable rate. The actual amount of gas delivered to the furnace is hard to determine, owing to leakage and the consumption in drying ladles.

Liquid fuels, such as crude petroleum or residuum, possesses a high calorific value, usually expressed at 14,000 to 17,000 B. T. U. per pound of oil. Because the oil being delivered directly to the furnace (see oil burning device and furnace construction for same) and igniting, when atomized by steam or compressed air, yields its entire thermal efficiency to work with no intermediate losses as is the case with gas, the value of oil over the latter is marked.



FURNACE ARRANGED FOR BURNING OIL.

It is difficult to make an actual comparison between oil and coal for steel melting on the basis of the cost of a ton of metal produced. The figures may be in favor of coal in certain localities, and in favor of oil in others. Yet the advantages of oil over coal in working results are so pronounced that discrep-

ancies in cost against oil are offset by its usefulness.

Ignoring the relative costs the principal points in favor of oil against gas will be considered.

First, the higher thermal value. A cubic foot of gas will yield 137 B. T. U. Taking 16,000 B. T. U. as an average of one pound of oil and allowing a cubic foot of oil at 57 11-100 pounds then 57.11 × 16,000 = 913,760. B. T. U. a substantial gain in favor of oil against an equal volume of gas.

Second. The simplicity of installation. One furnace will require a storage tank with a capacity of about 17,000 gallons, from this the oil is pumped to the burner (see cut) which essentially is the producer in the sense that the arrangement of the burner permits a necessary atomization of the oil by steam or compressed air before ignition. It is superfluous to make a further comparison on this point, in view of the crudity of the gas producer.

Third. The use of oil lessens furnace repair costs and allows longer campaigns before shutting down for general repairs. This point alone, is perhaps the strongest one in favor of oil. Conditions of brick work in regenerator chambers do not require the same attention with liquid fuel as they would with gas. That is to say, should there be leakages in the partition wall between air and gas chambers, they can be ignored, using oil; but with gas they would necessitate a shutdown of furnace to repair them. The same applies to ports and downtakes.

Fourth. The character of the oil not being subject to the same latitudes of irregularity as the composition of the gas, there results a decided gain in the certainty of the furnace's work. The temperature of the bath is under control, and regularity of output can be expected—a feature not so dependable with gas.

Fifth. The labor cost is greatly lowered. One man per working day attends the pumps. In the gas house there will be a foreman and several laborers to feed and poke the fires, and to wheel away the ashes. The labor in unloading and stocking coal is also eliminated. With these features can be mentioned the removal of the attendant dirt and smoke with gas producers; the loss of time in cleaning gas mains and other conditions that would occupy too much space to mention.

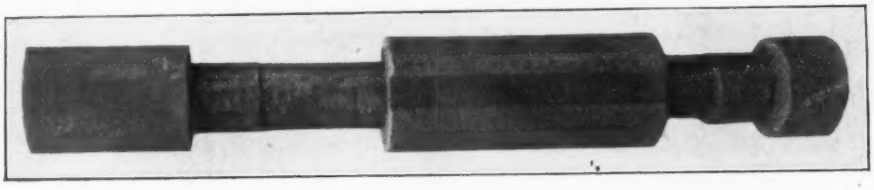


FIG. I.—CORE 4 FEET AND 10 INCHES IN LENGTH FOR A PUMP PLUNGER. THIS CORE WAS USED FOR A STEEL CASTING AND DID NOT CUT.

Oil fuel will also be useful for drying ladles, firing annealers, core ovens, etc.

CORE OIL AND OIL CORES.

BY W. P. HENEMANN.

A great many failures in this world, can be attributed to the fact that there was some imperfection at the very start of the enterprise or purpose. So the foundrymen have experienced that the core, upon which the casting depends and which is, for all practical purposes, the beginning or first step of a perfect casting, must be without any flaw and of perfect form and consistency. We may venture to say there is not a foundry in the country that has not experimented extensively with various methods of making cores with the result that they have found from these experiments certain classes of core mixtures more satisfactory than others. In fact, because of the trouble that is caused on account of imperfect cores, the foun-

dryman is always ready to experiment with any core mixture that to him looks in any way practical.

During the course of a year the loss which results on account of material consumed in making cores, the waste resulting therefrom, and the imperfect castings which cannot be put upon the market, or if used, may result in greater loss to the foundry than the mere material and time represented by the casting itself, is very considerable and it is the desire of the foundrymen to do their utmost to minimize such loss.

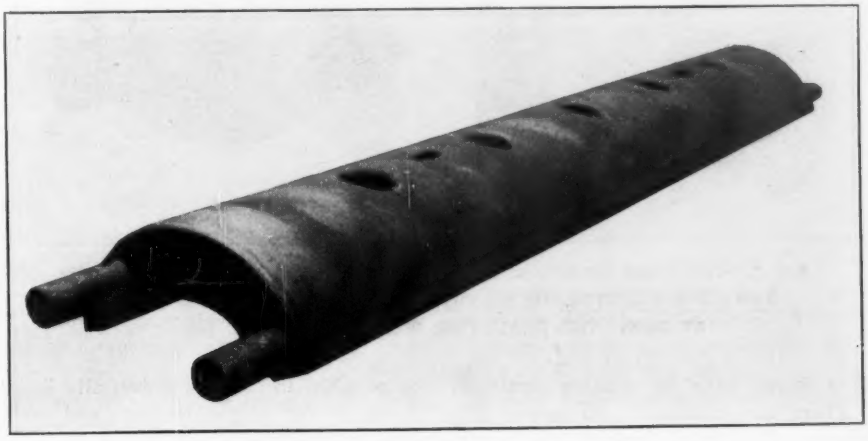


FIG. 2.—CORE WEIGHING 500 POUNDS, WHICH WAS SURROUNDED WITH 2,200 POUNDS OF IRON. THIS CORE IS FOR A STEAM PAN FOR A LAUNDRY MACHINE, THE VENT BEING TAKEN OUT THROUGH THE ENDS WITHOUT ANY SPECIAL VENTING DEVICE.

It will, of course, be recognized at the very outset that among the great variety of cores which are made, there are any number of core mixtures, or core compounds, that can be used with good results. The easier the core, the more of course, does this principle apply. When it comes to making intricate cores, cores which are made for castings that easily blow or cores which it is advantageous to make with as few rods as possible, then it is the object of every foundryman to use a core compound which is more reliable and has proven itself to be the most perfect core maker that can be procured.

A few varieties of core compounds and core mixtures which are used in the foundries throughout the land may be mentioned. For instance, cores made with flour and sharp sand will make very satisfactory castings in many cases and this combination is used in innumerable foundries. These cores result in a great waste of material as, after the mixture has served once it must then be sent out to the dump as waste. These flour cores are apt to be untrue to the pattern and the greatest draw back to them is that they easily take moisture and frequently blow. Many foundries prefer a rosin core or a core mixture made with rosin, flour and sand, but the general imperfections of cores of this kind, are about the same as those resulting from flour cores.

The work in the core room is in many respects exceedingly disagreeable and it is, of course, to the advantage of every foundry to make it as pleasant and agreeable for its employes as possible. The work with a rosin core is certainly far from being agreeable, for the smoke which fills the foundry when these cores are used in casting is most trying on the eyes and lungs of those who have to be near it and frequently men who are compelled to do this work look like "Chinese Monkeys" after having been in the smoke for some time. Some foundries are using and experimenting with various dry mixtures that are upon the market, with more or less success when used

in simple castings. On account of the various imperfections of the old and prepared mixtures, numerous foundries prepare compounds of their own with a view of avoiding the particular difficulties which they meet with in making castings.

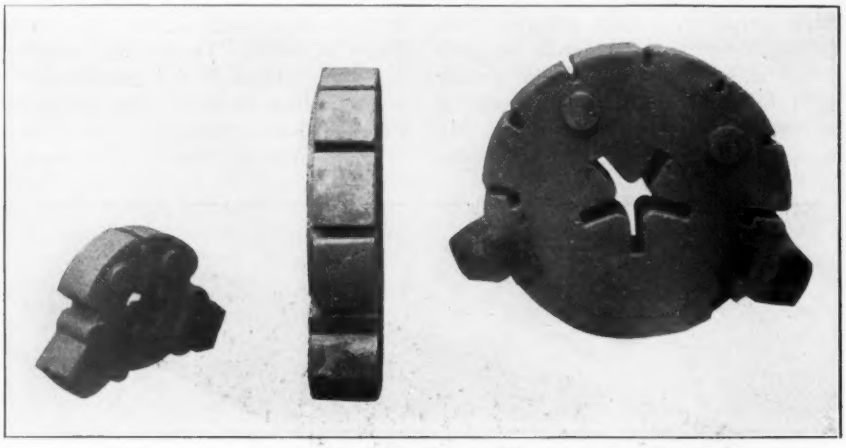


FIG. 3.—THE LARGE CORES ARE 2 FEET IN DIAMETER, AND 6 INCHES THICK. THE CORES WEIGHING 100 POUNDS ARE SURROUNDED BY 3,000 POUNDS OF IRON. THE SMALL CORE WAS FOR THE SAME JOB.

There are companies throughout the country who have devoted their entire energies to putting upon the market, core mixtures or core compounds which will do away with the disadvantages resulting from the use of the old methods, and they have met with more or less success.

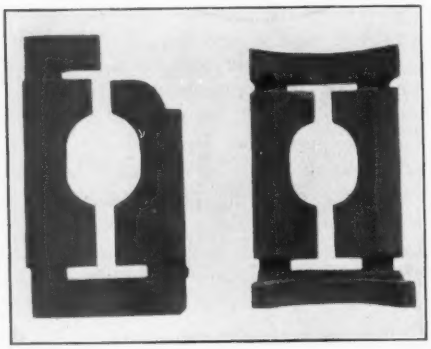


FIG. 4.—CYLINDER PORT CORES USED IN A MARINE ENGINE CYLINDER.

Among the most successful core compound manufacturers in this country is the Holland Linseed Oil Co., which has had fifteen years' experience in the making of oil core compounds. They have saved no labor or expense in making the most scientific tests, for the purpose of creating as nearly perfect a compound as possible, to be used universally in all foundries for simple, intricate and every kind of castings.

This company does not make a core compound and contentedly remain in the belief that no improvements can be made on it, but they are constantly at work making cores of the most intricate nature thus attempting to raise their compound

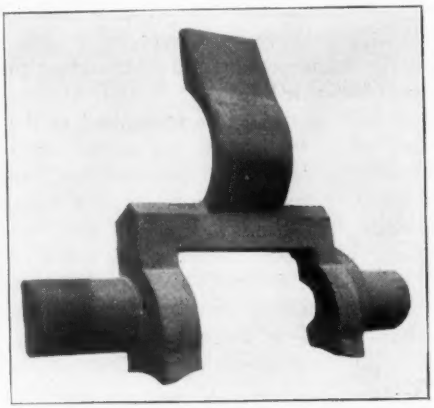


FIG. 5.—CYLINDER PORT CORE 2 FEET ACROSS AND 18 INCHES HIGH, FOR USE IN A MARINE ENGINE CYLINDER.

to a higher state of perfection. Results from these experiments in their laboratory and workroom and also from placing samples for practical tests with some of the best foundrymen in the country, show

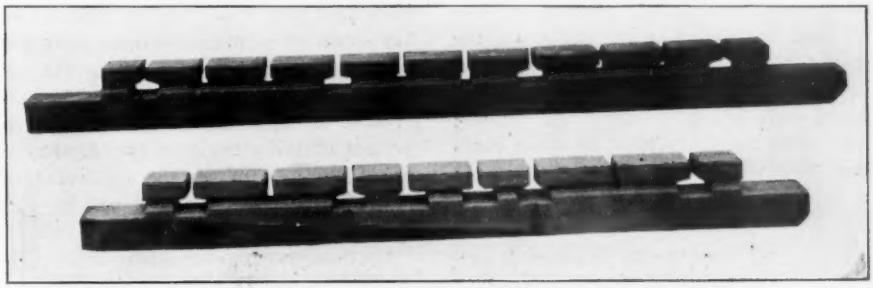


FIG. 6.—THE LONGEST CORE IS 6 FEET IN LENGTH, AND IS USED IN MAKING THE TYPE BED FOR A PRINTING PRESS. THE SHORTER CORE IS FOR THE SAME PURPOSE.

they are able to meet the difficulties which may come to their notice through their foundry customers.

The fact that pure linseed oil cores, in many instances, give very good satisfaction, is true beyond question, but it will be conceded that it is not a perfect core

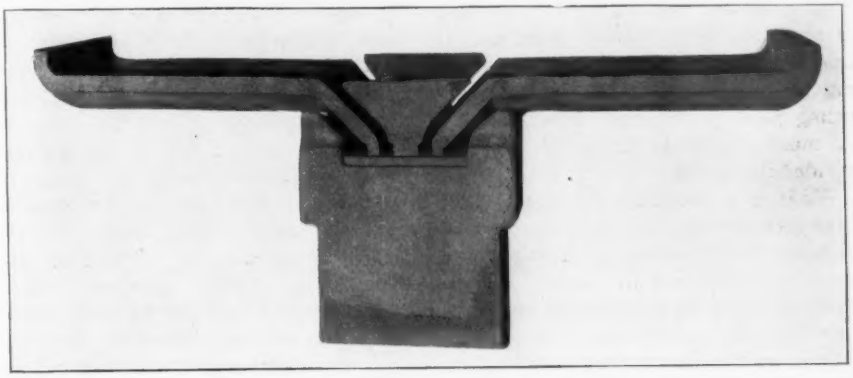


FIG. 7.—PORT AND STEAM CHEST CORES FOR MARINE CYLINDERS. THE EXTREME LENGTH OF PORT CORES, 4 FEET.

compound and that various draw backs, the unwholesome smoke, the compactness of the core after baking, etc., resulting from castings made with pure linseed oil cores are serious disadvantages. Such disadvantages can be done away with if their cause can be discovered and removed.

If foundrymen will take the time to figure the actual cost of making rosin or flour cores, and add to this cost the loss which results to them on account of poor castings and failures, they will in many cases come to the conclusion that oil is the best binder they can use. Oil cores can be made with very few or no wires or rods, which adds strength to the casting and also saves the time required to put wires and rods in place, saves the time of cleaning castings, the time of straightening rods, not to mention the additional saving of not being obliged to buy rods. Oil cores can be rammed up and completed quicker than flour or rosin cores which again is a saving to the foundryman. Oil cores will be found to be smoother, to stand rougher handling, resist moisture, stand more heat, and answer other requirements of the foundry much better than flour or rosin

cores. This will be found to be true if flour cores, rosin cores and oil cores are put aside for several weeks, when it can be demonstrated that the oil cores are much superior to the others.

In making oil cores, sand thoroughly mixed with the proper amount of core oil and moistened with water to the proper consistency is used, sharp sand being preferred. In some cases it will be found more advantageous to use molding sand with the sharp sand, to make cores keep their form while baking.

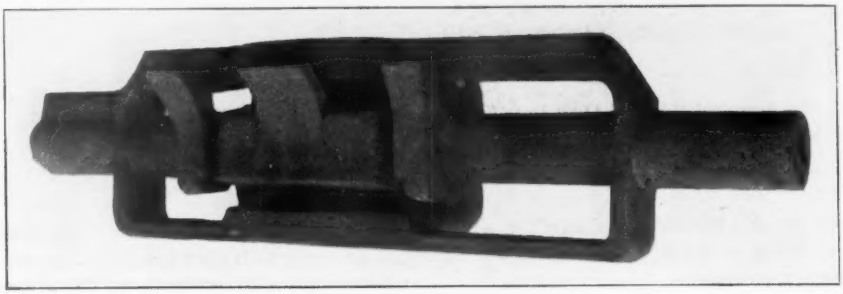


FIG. 8.—A STEAM CHEST PORT CORE 30 INCHES LONG.

Perhaps, the greatest objection to the old way of making cores is the fact that gases generate when the cores are baked or the metal poured about them and in order to avoid their blowing or sputtering, foundrymen are in the habit of providing outlets for the gases generated, and in many instances the trouble can be avoided by venting.

While it is comparatively easy to vent large cores, which offer ready access to all portions thereof, it requires great patience and forethought and the utmost skill to leave sufficient open channels in small and intricate cores, for the outlet of the gases. In venting small cores, there is also danger of the metal finding its way into the vents. Where cores are required that do not permit an outlet of sufficient size to carry away the gases, the foundryman is in rather a desperate position unless he resorts to an oil core.

In making oil cores, the foundries use what they term "a good sand" by which they mean sand which contains sufficient loam to hold together. Where this sand cannot be obtained easily, molding sand may be added, as before stated, or sharp sand may be mixed with clay wash. It must, however, be remembered that a mixture with clay wash, will not be found very satisfactory where the greater part of the cores are surrounded by iron. For such cores it is preferable to use fine sharp sand and if this can be obtained no clay wash is required. Linseed oil has been used with great success in making cores with sharp sand, but some unpleasant features remain and it has been the aim of the manufacturers of oil core compounds, to eliminate the disadvantages which are found when pure linseed oil is used. There is almost as much chance for linseed oil cores to blow as cores made from flour.

The principal ingredient of the liquid core compound of the Holland Linseed Oil Co., is linseed oil and the compound is so manufactured that it will permeate the whole core, covering the grains of sand without filling the cellular spaces of the sand as do flour, rosin, molasses and other substances. The core mixture made with Holland liquid core compound need not be used immediately after mixing. When the mixture is used it can be easily molded and handled before it is baked. After baking, the cores are infinitely stronger than cores made on the old plan. In casting, these cores require no venting in many cases, which alone is a matter of great importance to the foundrymen.

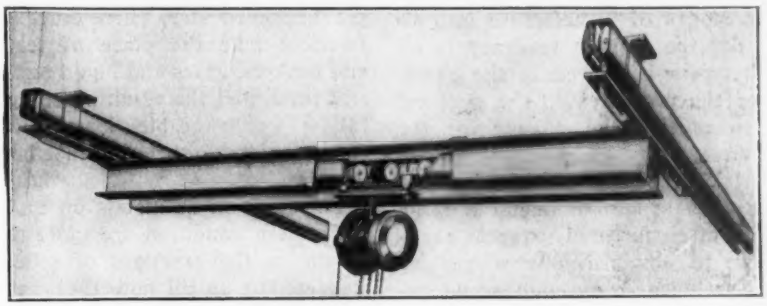
The Holland Linseed Oil Co. prepares a compound that may be used with great success in both coke and steam ovens. They also prepare a core compound that has extra quick drying quality, and may for that reason be preferred in many instances for use in steam ovens, or even

in coke ovens and in making heavy cores and for steel castings.

This is an age of most complicated and perfect machinery and the problems which confront the foundrymen are more difficult than they have ever been before. A foundryman expects more from his molder than he ever did before and it is an absolute necessity that the cores which he uses in making intricate and fine castings, should be perfect. It is, no doubt true that the foundryman has kept step with the age and has adopted ways and means of making cores according to the most modern and approved methods.

A SERVICEABLE TRAVELING CRANE.

For narrow spans and comparatively light loads some form of inexpensive traveling crane has long been desired. The accompanying illustration shows a form which has many advantages and can be used for spans up to 25 feet and loads up to 3,000 or 4,000 pounds.



A SERVICEABLE TRAVELING CRANE.

The crane runway is made of Coburn trolley track, while the crane itself is composed of two channels placed back to back between which is suspended by brackets a section of Coburn track. The trolley hoist operates in this section, and may be either a differential chain block or one of the power hoists operated by electricity or compressed air.

The ends of the crane are attached to supporting trolleys in the runways by pendants in such a way as to distribute the load equally between the 16 supporting wheels.

The trolleys are roller bearing and the parts have been so designed as to give long life and easy operation. These cranes are especially advantageous for side floors, core rooms, cleaning departments and similar locations in foundry construction. The device is manufactured by the New Jersey Foundry & Machine Co., of New York City.

THE SMOKE QUESTION.

One of the subscribers to THE FOUNDRY sends in the following: "We have been asked by the board of health of our city to eliminate the smoke caused by the lighting of the fire in our cupola, and would be pleased to have the readers of THE FOUNDRY, that have had any practical experience in the matter, to enlighten us on the subject.

"We have a cupola 66 inches in diameter inside the brick and we put in enough wood collected around the works, old boxes, etc., to thoroughly ignite 1,800 pounds anthracite coal. After this is ignited, we charge in the rest of the bed about 3,000 pounds coal and 400 pounds coke. We then use coke between charges of iron. The cupola stack is 50 feet high and all the smoke comes out in 15 minutes after lighting. It is thick and heavy, but as soon as the fire comes through the coal, we do not have any more smoke during the rest of the heat.

"We have tried several different ways of lighting, but all to no effect, and would be pleased to learn if anyone has overcome this difficulty and how they did it." J. W.

BRASS FOUNDING

THIS DEPARTMENT IS DEVOTED TO THE TREATMENT OF ALL ALLOYS INCLUDING THEIR FOUNDING, GRINDING, POLISHING, ELECTROPLATING ETC.

PRACTICAL ALLOYING. VI.
Some Difficulties of Alloying.

The difficulties in the way of making alloys are many and real. The common difficulties attending most manufacturing processes may generally be overcome by diligent application and the observance of well known laws and conditions, but the combining of metals to form alloys cannot always be regulated by the normal behavior of the individual components. Some knowledge of chemistry and the chemical relations of the elements is absolutely essential to the intelligent handling and treatment of the metals throughout the various stages of manufacture into alloys. But the modern tendency in all manufacturers is to reduce the chemistry of the processes to the simplest form so as to make it easy for the unskilled worker to produce correct combinations. In photography, the amateur has at his command a large selection of compressed reagents enabling him to obtain results which, for lack of technical knowledge or on account of the expense, he could not otherwise reach. In medicine, too, the physician, by means of tabloid preparations, is able to relieve his patient of much of that nausea following the use of liquid drugs. And in the metal world the principle of preparing concentrated alloys of metals which, subjected to the ordinary treatment, unite with difficulty, has grown within the last 20 years to be a specialized industry, making it possible for the general founder in alloys to produce economical and reliable combinations of volatile and highly refractory metals.

These tabloid alloys, if we may so name them, have been a great boon to foundrymen. We all know the danger and uncertainty attending the direct introduction of phosphorus, mercury, magnesium or aluminum, into molten metals at high temperatures. The brassfounder has benefited greatly by this new system of alloying by "concentrates." Cupro-manganese, ferro-zinc, aluminized-zinc, phosphor-copper, phosphor-aluminum, phospor-tin, and silicon-copper in guaranteed proportions, are easily procurable by the foundryman, and they are quite as convenient as prepared reagents are to the practical chemist. Indeed, practical alloying in its modern aspects may justly be described as a higher branch of practical chemistry, where crucibles and furnaces take the place of test-tubes and beakers, gases and liquid metals act and react, and the resulting compounds follow unchangeable laws with the same accuracy as we find in laboratory practice.

The reaction of metals on metals in the molten condition are quite as consistent as the reactions of other substances, but up till now they have not been classified.

Metallurgists have been too busy grappling with problems arising out of the physical conditions and relations of the metals to exhibit the chemistry of alloys with anything like fullness. Nevertheless the subject of metallic reactions is one deserving of the fullest investigation. If foundrymen in their everyday experience have had it demonstrated that the presence of manganese tends to precipitate sulphur in cast iron, the presence of aluminum tends to precipitate lead in brass, the presence of antimony tends to precipitate copper in silver alloys, and additional copper tends to precipitate lead in pot metal mixtures, surely an extend-

ed list of such reactions would mark the danger line in certain mixtures and help the founder in alloys to a better and more scientific method.

In alloying, the chemical qualities of the metals are of the very first importance; and still the general approach to the practical combination of metals is made by experiment and deductions from physical tests. It is here the difficulties in alloying metals begin. We make utility the supreme test of a metal and all our standard metals are the product of extended experiments. These standards are liable to be displaced by later experiments and the discovery of new methods of combining the metals. And in every case the excellence of the later product might have been attained through a closer study of the chemistry of the alloying metals.

The improvements in bronze due to the introdction of chemical equivalents of phosphorus, manganese, etc., and the superiority of sterro-metal based on the chemical affinity of zinc and iron afford striking proofs of the advantages of chemical as opposed to the mechanical solution and combining of metals. Of course, in ordinary melting practice there is always a tendency for the metals in an alloy to cool out according to their specific gravities, and if there is much difference in their melting temperatures, the more fusible metal is apt to liquate after the principal alloy has set. Exceptions, be it noted, are metals which enter into chemical union, or metals which may be freely mixed in all proportions showing always the qualities of a true mixture by the predominance of the physical properties of the metal present in excess. Common examples of the latter are: Copper-zinc alloys, aluminum-zinc alloys, lead-tin alloys, and silver-copper alloys. Such metals present few difficulties in working and perfect casting alloys may be obtained by the "direct" method (i. e.; the more infusible metal is melted first and the desired proportion of the more fusible metal is dissolved therein).

Metals which are liable to liquate out of an alloy require to be constantly stirred while liquid and to ensure sound castings they should be remelted, cast at a low temperature and cooled as quickly as possible.

Alloys for castings are only of service when the metals entering into the composition can be made to unite and from homogeneous compounds. It follows therefore, that the first aim of the workman in making alloys is to unite the metals in such a way that the finished product will retain all the characteristics of a true metal. Many metallic compounds that we know of are utterly useless for any of the purposes of a metal. That the metals have stronger affinities for the non-metallic elements than for other metals is amply proved by the condition of the majority of the ores from which they are derived. In nature "free" metals are the exception. All metals combine with oxygen, sulphur and other radicals in proportions which to a great extent are determined by the temperature and their environments.

Oxidation is the chief hindrance to the perfect union of metals as alloys, and oxides are the bane of metal mixers. As a rule the activity of oxygen in combination with fused metals increases with the temperature and also with every additional element present in the alloy. Complex alloys are therefore not so easily manipulated as alloys of two, or perhaps three metals.

The mere surface oxidation of metals is not nearly so harmful as the formation of oxides by metallic reactions, some of which have already been noted.

When the oxides of the constituent metals dissolve in an alloy,—or rather, are carried in solution,—the resulting metal is always materially decreased in strength, tenacity and homogeneity. The usual precautions against oxidation are not equal to the prevention of a certain loss in melting but by special treatment alloys may be prepared free from oxides.

The liberal use of suitable fluxes and materials to exclude the access of air is practiced in every brass foundry; and in some cases special precautions are taken to preserve a deoxidizing flame within the furnace. The choice of fluxes

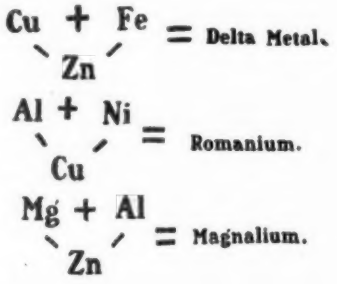
for alloys and the part they play in removing impurities and in reviving the fluidity and other properties of the metals, constitutes an important branch of the business of practical alloying:—a branch which demands close reasoning and discernment of the chemistry and the physics of materials. That being so we shall do well to devote a separate chapter to foundry fluxes and their effects. But to return to our "difficulties,"—the shrinkage of alloys and their habits of congealing give the brass founder more pause than the mere reduction and blending of the metals.

The rate of melting, the temperature of casting and the rate of cooling are three very important factors in determining the density, grain, and soundness of alloys. No metal can be melted without decomposition but the ultimate composition and the physical qualities may be controlled within well known limits. Foundrymen are well aware that some alloys are stronger than others even when chemical analyses prove them to be identical in composition. This should draw attention to the fact that alloys are extremely sensitive to heat treatment. The effect of high temperatures on metals of low fusibility is always harmful; favoring the absorption of gases, the formation of oxides and inequality of the properties usually associated therewith. It is a common delusion that the metals in an alloy should be melted hot to ensure a thorough mixture; it is also a common mistake of some molders to demand hot metal for all kinds of castings. The tyro at mixing alloys frequently blunders because he does not understand the delicate nature of forces nor the susceptibilities of materials in an atmosphere of 2,000° F or thereabouts. He regards heat as the influence to which all metals must succumb; and he does not seem to be aware that many of the metals may be more easily dissolved in, and more safely and perfectly combined with other metals at lower temperatures than the melting point of the most refractory in the series.

Combustion of the metals is useful in certain refining processes but it is altogether an undesirable incident in alloying. No, it won't do! To alloy metals properly one requires to be more than a diligent fireman. For every alloy there is a "proper heat" beyond which it should not be raised, and a "casting temperature" at which the best results are to be obtained. "Proper heats" and "casting temperatures" will some day be standardized and included in the specifications for standard alloys; but it is never safe to predict finality in the methods of their preparation.

It is an axiom in the metal trades that the most refractory component in an alloy should be first reduced to form a bath in which the more fusible metals may be dissolved. This custom dies hard, nevertheless it is doomed: the introduction of intermediate alloys, as ferro-zinc in delta metal: "hardening" in babbit metals; and cupro-manganese in manganese bronzes has changed the general practice of combining metals by their solubilities to the more effective chemical methods of modern times.

The most widely diffused metals are not necessarily the most easily reduced or alloyed. Aluminum has always been plentiful but it is only beginning to be a profitable product; iron also is plentiful, but it must be used sparingly in alloys. Many of the metals do not make practical combinations by the ordinary methods of alloying, while others are favorably influenced by the introduction of another element. It sometimes happens that the addition of a third element favors the union of two non-combining metals, thus:—



Again, goldsmiths use gold alloyed with copper and silver in preference to the copper hardened or silver hardened metal. The three metals combine to form tough, malleable and ductile alloys of better working qualities than those obtained by using copper or silver alone, as the alloying metal.

Fortunately the difficulties arising from impurities in the metals are lessening, and today it is not nearly so needful to remelt alloys made from good brands of the metals. It suffices for most requirements if only a portion is remelted. Of course we have to admit that any treatment of a metal which increases its density usually increases the strength also. But as most metals lose in fluidity every time they are remelted it is recognized that melting a portion of the new metals with the already mixed alloy is advantageous. Some alloys are less fluid at higher temperatures than they are at a moderate heat above the melting point. Aluminum alloys and antifriction alloys of zinc, copper and tin behave in this way; they are easily overheated and much waste results from careless melting. The microscopical examination of alloys has confirmed the belief that the temperature and melting conditions exert considerable influence on the permeability of the metals. Metals which appeared to be saturated with some particular alloy have, by changes of temperature and melting methods, been made capable of taking up more of the alloy. The variations in the molecular condition of different specimens of the same alloy, are also largely due to variations with melting practice. We have already said metals are now obtainable in comparatively high conditions of purity, but it is not always easy to keep them so, particularly when their fusibilities are unyielding.

The higher the temperature at which a metal becomes fluid the more readily does it occlude gases and absorb impurities; hence the difficulties of alloying increase with the temperature required to reduce and combine the metals. In Cowle's electrical method of producing aluminum bronze, it is assumed that the aluminum and copper unite when both are in the gaseous condition, and by this means "a completeness of union between the constituents of the alloy is obtained, superior to alloys formed in any other way." Here is a method of alloying which awaits development: All metals may be heated until they assume a gaseous condition, but only the records of the patents office reveal to us examples of metallic combinations of this unique order.

The modern practice in alloying metals which are difficult to unite by "direct" method is to present one of the metals in a nascent condition. For example, Dr. Goldschmidt's process of alloying tungsten with aluminum, (for the production of "wolframinium") is accomplished by adding tungstic oxide to the reducing bath in the manufacture of aluminum. Again, to alloy nickel with aluminum is not an easy matter: rich alloys of the two metals are generally made by adding NiO to a bath of Al.

Up to the present we can alloy metals of every class and enhance such desirable properties as color, strength, sonorousness, flexibility, etc., but not by rule or rotation. Anomalies occur in the practical processes of alloying which demand special treatment.

The properties of the various metals undergo such diverse changes in the heat and they are so easily influenced by the presence of minute proportions of other bodies that no hard and fast rules can be given for combining them into alloys.

The iron founder has only to study the fluid characteristics of cast iron, and with ordinary skill in molding he should secure good castings. It is different with the founder in alloys, he strikes new features with every change or addition in the metals. Due to long experience, brass may be cast with reasonable prospects of good results in the castings; but add another element to it,—iron, manganese, aluminum, nickel,—and the new combination defies the old experience. Gates, ramming, sand, venting, and melting methods all require modification.

In short, the physical properties of alloys depend upon their chemical composition *and also upon the treatments,*

thermal and mechanical, which they undergo: So that, to possess the correct formula for an alloy and not to know the correct treatment for the combining metals is like trying to solve a puzzle without the key.

The chemistry of high temperatures and the reactions of metals are at the root of all the changes and troublesome modifications encountered in practical alloying. When this side of metallurgic endeavor is better delineated and better understood, the practical difficulties of alloying will be greatly minimized,—at least, so far as alloying with *new* metals is concerned.

Unfortunately there is a growing practice in the various kinds of metal foundries of using mixed metals to produce standard alloys economically. The purchase of these mixed metals or scrap alloys by specification is too ideal for present day consideration, so grading by fracture and color is adopted. It has been borne in upon iron founders that grading by fracture is a lottery; by and by the same idea will penetrate to the brass foundries the type foundries and the so called metal refineries. It is admitted that some outlet must be found for old metals, but the miscellaneous scrap heaps of the junk dealer grow more treacherous every year; the values are often fictitious, and nothing short of a remelt and analysis should satisfy anyone desiring to be honest in building up alloys from scrap and mixed metals.

I was once called upon to find a use for about four tons of mixed babbitt and anti-friction metals collected by my predecessors from ships and engines undergoing repairs. With difficulty I persuaded the management to stand the expense of melting down the lot into ingots. Drillings were taken from each ingot and again the drillings were melted for analysis. This showed:

Tin	55.69
Lead	32.04
Antimony	8.65
Copper	1.95
Iron	0.18
Zinc	1.13
	99.91

Now it should be evident to anyone acquainted with anti-friction metals that this mixture could only have a limited application. By the judicious addition of tin, copper and antimony, a good serviceable bearing metal was produced, and the economy was so great in this instance that the firm afterwards adopted the same method of dealing with brass and gun metal, scrap and castings left on their hands by customers. They found it paid better to know just exactly what they were putting into the daily mix. In dealing with old metals and analysis gives the like asistance to the meatl mixer that a chart gives to the mariner.

AN UP-TO-DATE BRASS MANUFACTURING PLANT.

There are two conditions which any company must fulfill if it is to be successful in the modern competition for trade. In the first place the quality of the goods produced must be made the first consideration. Second, the company must specialize. Quality is a relative term and may be defined in a commercial way as the amount which one obtains for his money, but in the broader sense when we speak of first quality or the highest quality of goods we mean the best goods that can be made for the purpose for which they are intended regardless of price.

The Glauber Brass Mfg. Co., of Cleveland, O., has been in existence some 15 years, and has built for itself a very enviable reputation for the production of high class brass goods for plumbing, water works and gas companies.

The principal product of the factory consists of stop cocks and bibbs. The Glauber company has not cast a pound of yellow brass in 15 years, all of the output being made from the best quality of red metal. All of the goods are guaranteed for five years, and a guarantee certificate is furnished with each shipment. It is evident that this policy has imposed rather a difficult task on the manufacturing department and it is interesting to note how it is met.

Foundry Department.

It is natural to follow the work through the plant from the first department to the finished product. The

foundry department occupies a room with a very high ceiling. This room is well ventilated so that the fumes from casting pass off very quickly, indeed. The metal is all melted in crucibles in a battery of furnaces situated in a room at one end of the foundry proper. The foundry room is divided into two divisions; in one half of the room the work is all put up on molding machines while the other half is devoted to bench work.

In order to reduce the handling of supplies and materials to a minimum the sand bins are located at one end of the foundry floor in one corner of the building, and the core department across the balance of the end of the building. The stock cores are made, baked in ovens and taken from the ovens to storage racks at the end of the foundry where they will be ready for the use of the molders. Upon each of the floors there is a large water tank for dipping the castings to blow out the cores and give the proper color. One of the accompanying illustrations shows a gate of castings as they came from the sand which were photographed by the writer.

All of the pot skimmings and shot metal from the floor is collected and ground in a water mill; the pure nugget metal is remelted, while the fine material from the slag, skimmings, etc., is sold to dealers.

The core department is one of the cleanest and best fitted we have seen. Each girl is provided with a stool. The sand is brought to them and the cores taken from them so that the work is not hard. Most of the cores are very small and metal core boxes are used for their production. At this point it may be well to mention that in this plant quality rather than quantity is the factor for which the management is striving.

The core ovens are fired with natural gas and are of the shelf type.

At one end of the core department is located the metal pattern department both for the manufacture and repair of metal patterns or core boxes. On the floor below, that is, in the basement, is located the fireproof vault or metal pattern storage. The metal pattern room is equipped with all machines necessary for the complete finishing of metal patterns.

PART OF THE MOLDING MACHINE DEPARTMENT.

Toilet Arrangements.

In the basement of the plant, under a portion of the manufacturing department, are located two sets of independent toilet rooms. The one for the men has several entries from the different departments in which the men are employed; while the one for the girls is entered from the end of the core room. The general arrangements of the toilet rooms are similar. The lockers, 400 in all, are in groups of ten, five on each side of a narrow aisle. At the end of each of these aisles there is a partition with a door. This door is kept locked during working hours and is only opened by the attendent in charge of the department at such times as the employes are passing to or from their

PART OF THE CORE DEPARTMENT.

work. This protects anything which the employes may leave in their lockers during working hours.

For washing porcelain lined sinks are provided with a supply of hot and cold water. These are about 20 inches wide by 30 inches long, and one or two men wash in each. The men's wash room is in charge of an attendent who is always on duty and who keeps the place clean.

Manufacturing Department.

There are two divisions to the manufacturing department proper. In the machine department all parts are machined and finished so far as they can be by the machine tools and the cocks are entirely finished in this department. The bibbs and other parts which require polishing or nickeling are machined in the machine department and then passed to the polishing, assembling, coloring and nickeling departments. A great deal of careful planning has been done in laying out the equipment for the machine or finishing department. Turret machines are used wherever possible.

One man in the cock reaming department has been reaming cocks for 40 years. He has been with his pres-

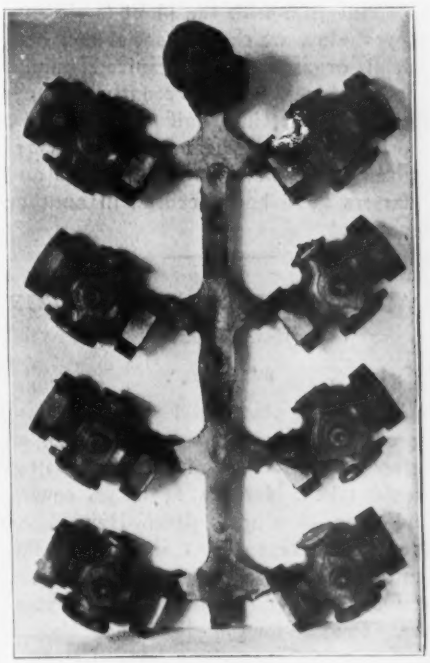
A PART OF THE MACHINE DEPARTMENT.

GRINDING COCKS BY HAND.

ent employers 15 years. After the cocks have been reamed and the plugs fitted they are ground one at a time by hand. The pieces are inspected after each operation and many of them are rejected after machining while many are also thrown out after grinding. After grinding the cocks they are assembled and then taken to the testing department for final test. Any cocks which even show dampness when tested under 200 pounds of water pressure with the cock first open and then closed are rejected. Those of the cocks which pass inspection are taken from the testing room to the packing department and packed ready for shipment.

The work which requires polishing or nickeling passes from the machine department to the polishing room in which are located the polishing machines equipped with an exhaust system which removes all of the dust, leaving the room perfectly clean. As in the other departments, the work here is all day-work and not piece-work. After the work is polished it is buffed and then tested. If the work requires nickeling it is polished, buffed, nickeled and then tested, after which it is simply colored and then packed ready for shipment. Nickel plated work is colored before nickeling and re-colored after nickeling.

The works were established by Mr. I. N. Glauber, (now deceased) and his two brothers, M. H. and J. H. Glauber who now conduct the business. There is also a superintendent over the entire plant and a departmental foreman in each department. The present output of the plant is about 4,500 cocks and



A GATE OF GOOD CASTINGS.

A CORNER OF THE GRINDING ROOM.

faucets every day, and as each one contains from three to seven parts it will be seen that this output requires the handling of a great many pieces.

One point that is of special interest in connection with the plant is the employes' club, which is a social and beneficial organization, organized among the employes. Until recently this organization met in a hall situated in the works, but at present the hall is required for manufacturing purposes and quarters have been secured in another location.

CASTING GERMAN SILVER FOR ROLLING.

BY MELTER.

In the first place build yourself a furnace that will accommodate a No. 60 or better still, a No. 70 crucible. The latter would take a furnace 14 inches square and 9 or 10 courses deep. Have draw fire-bars, these to be 1 inch below the bottom frame of the furnace, thus giving you always a good draft through your fire. The flue for this size furnace should be 6 x 9 inches, nothing less. The ash-pit, 18 to 20 inches below the fire-bars and cleaned out every morning or every time you draw the fire. If you have the ash-pit too deep you lose the draft, as the air is floundering about until it finds force enough to carry it through the fire.

When lighting a fire for melting, place a salamander on the fire-bars on which to put the crucible, thus preventing the crucible from getting on the bare fire-bars, also keeping plenty of fire under the crucible. If you do not use a salamander you must lift up the crucible every once in a while in order to get the fire under the crucible, as the weight of the metal will cause the crucible to work its way to the bare fire-bars and the bottom of the crucible will be cold, making it a moral impossibility to get the metal hot enough. (This applies in melting German silver. Brass and other metals have no need of a salamander, but you must have a good fire under the crucible in melting any kind of metal.)

Place the crucible in the center of the furnace and put the fuel in equal parts around it. Put in the crucible a good layer of pulverized charcoal, then your copper and nickel, then the flux. Put on the cover. Be sure and have a good fire.

When these are melted, stir well with a black lead stirrer, then put in your scrap if you have any, and last of all your zinc, but be sure your metal is ready to receive it, otherwise you will find a pasty substance on top, which, when you skim it will come off in lumps and the right thing for you to do in a case of this kind is to break it up and melt again. Then again, if your metal is too hot before

you put in the zinc, a large portion of it will go up the chimney, the metal in the pot will boil over, causing a great loss, and besides, you lose your proportions, spoiling the pot of metal. The best thing to do when you find your metal too hot to take the zinc is to put in a small amount of scrap the grade you are making and it will cool it off, then put in the zinc, giving it a good stirring with the stirrer, let it stand a few minutes and stir again well, and when hot enough pour.

When pouring be careful not to let any dirt get into the mold. Hold the skimmer in front of the stream, just on top of it, not in it, for if you hold the skimmer so that the molten metal touches it it will melt the skimmer. Pour a good steady stream, not too strong, as it will boil over the mouth of the mold, and on the other hand, if you do not pour it strong enough the edges of the ingot will come sooty and dirty and also very likely crack in rolling. The size and strength of your stream must be governed by the size of the mold you are using.

A word in regard to the molds. My experience has taught me that you cannot get good results casting wide metal. I think about 5 inches wide is the best for sheets, for flat ware you may use 6 to 6½ inches, but it is best to spread it in the rolling from 5 inches. If you should want to cast wider metal than 6¼ you may get it by a shorter mold, say 15 inches long, whereas the 5-inch mold may with safety be 26 inches. The molds for German silver should be a little full in the center, that is, they should be 1-32 thicker in the center than at the edges, so the pattern should be made 1-64 full in the center of both the top and bottom sides. That would give the strip of German silver 1-32 thicker in the center than at the edges when cast. The reason for this is that it gives the metal much better chance for shrinking, when in the course of casting, than it would have if the ingot molds were flat. In fact, you could not cast German silver in flat molds.

Quite often the castings for new molds are bent when they come from the iron foundry, I suppose on account of the patterns being taken from the sand improperly and they then have to be straightened. There are two ways to accomplish this yourself. One is to put them together in the fire and get them to a red heat, clamp them together and let them cool off. Another way is to get them to a red heat and place them together on a level place, weight them and let them cool off. The right way to do is to give them to the machinist, then if they are humpbacked or bowed at all he will hammer them straight without heating them at all. He will then put them in a planing machine, skim off the top skin of the flange of the mold where the two parts meet (not on the inside of the mold where the metal is poured, as that would take off the hard surface and if that is taken off the hot metal is liable to bite the mold). Then they run the file over them and you have a good mold and when you pour in the metal there is no feather edge to file off but the edges are sound, and if the metal cracks in the rolling it is not the fault of the mold, but either of the melter, or the metal itself.

A melter should be able to use his own shop sweep, that is, the black dirt which accumulates just where he stands by his furnace and around his ingots where he poured off his metal, also the skimmings, or rather these should be saved and washed. The ashes should be sold, unless you have facilities to grind and wash them, etc. If this were done there would be a large saving in the cost of castings and many would find that it would work to their advantage. While in England I used to cast by contract, so much per ton, employ my own labor, and was allowed less than 2 per cent loss on the whole. (All grades of German silver, brass, bronzes, gilding metal and copper.) I had to hustle to make both ends meet, but I did it. There was nothing sold, neither skimming, shop sweep nor ashes. They could tell what loss there was, as the metal was weighed out to me, credited to me when cast into strips and a regular debit and credit account was kept. That I think is the right way to do, for in so doing there is no fear of unnecessary waste.

To prepare the molds, use lard oil, or some other strong oil will do as well, as I have had very good results from

vacuum oil. When you have oiled them, close them and clamp them together with iron clamps made to fit the molds. Then they are fastened with iron wedges. This will keep them quite tight while the metal is being poured. The above instructions about molds will apply in every particular to gilding metal and copper, in fact, any metal rich in copper, but these metals you can pour into wide molds, the same length as the narrow strips.

In making German silver the very best metal is an absolute necessity. You must have the best lake copper, the purest nickel you possibly can get and pure Birtha zinc. In my opinion the natural draft furnace is the best furnace for making German silver. After the first melt it will cost no more for fuel, that is, to use coke, than it would for oil. I have tried it time and again. Years ago when I was making 18-cent German silver, the cost to melt, say 100 pounds, was from 6 to 7 cents for coke, as it would only take a bushel of coke to melt 100 pounds. The true economy is the use of coke or coal, for the life of the crucible is twice as long with either of them as with oil. Then again, with oil the furnace wants re-lining every few days, where with coal or coke it will last for 4 or 5 weeks.

Rolling and Annealing German Silver.

When breaking down German silver you should have good strong rolls with good necks and strong housings, as there is considerable strain on the rolls. When breaking down 9 to 18 per cent German silver, have your strips rolled enough so that they will stand the fire without cracking, take them to the muffles and have them annealed, but do not keep the metal in the fire longer than necessary. Get the metal to a cherry red, then take it out and lay it carefully aside to cool off. Don't by any means handle it roughly while hot or you will cause it to crack and don't throw water on it, as that will sometimes crack it, as it is very sensitive when hot and great care should be exercised when handling it until it is cooled off. When rolled down a second time, it should be scraped on a scraping machine before being annealed, to take off the outside skin which is liable to be spilly, then anneal and roll again and if the metal is for any particular purpose, it should be scraped a second time. Anneal and roll it down to the required gauge. German silver can be rolled and cross rolled into sheets to any width. When annealing German silver, at any stage of the rolling process do not leave it in the fire after it is hot enough, just get it a nice cherry red and let it go at that.

BRASS FOUNDRY NOTES

BY C. VICKERS

SOUND BRASS CASTINGS.

I notice an article in the brass foundry department on "the prevention of porous and unsound brass castings."

Now, I do not agree with the modern proverb, "knock and the world knocks with you, boost and you boost alone," so I am not going to attack the deoxidizing agent mentioned, further than to say I do not believe it will prevent porosity in brass castings any more than will phosphor bronze, and I have tried them both. Phosphorus as is well known is a powerful deoxidizer, but even phosphor bronze will frequently run spongy. Alloys of copper, tin and lead deoxidized with 1 per cent of phosphor tin, have in my experience cast defective more often than the same alloy, containing 4 per cent of zinc, in place of the tin phosphide.

In my own practice, therefore, I have abandoned the use of small quantities of phosphor tin as a preventative of porosity.

The best safeguard against porosity in brass castings, is intelligent melting. This point cannot be too strongly emphasized.

I do not expect everyone to agree with me on this point, because I can remember the time, when I did not believe it myself.

Many thoroughly good brass molders, go through life, and never run up against the spongy casting problem sufficiently hard to cause them any sleepless nights. I had one ask me the other day, if I believed in the possibility of metal being "burnt" and it took considerable argument to convince him that I had good reason to so believe. "Burnt" metal is another name for oxidized metal, copper

or any of its alloys may be very easily oxidized in the furnace. Sometimes on removing a pot of metal from the fire, we find ourselves skimming off a mushy mess that we know is metal, and yet cannot use as such, because it will not liquefy, so we are obliged to skim it off. This mushy stuff is oxidized metal, and before we can again use it the oxides must be reduced by means of charcoal.

If we pour any of the metal in that pot into castings, these castings are invariably spongy. The causes of this condition of the metal are: First, the use of highly oxidized material, as scrap copper wire of small diameter from which the insulation has been burnt.

Second, by improper charging of the pot, or, third, by "holding" the metal at a boiling point, in the furnace, without any protective covering.

When metal is "held" it should never be permitted to boil, although it may be kept hot for hours if properly managed.

When metal is "burned" by improper charging, it may when removed from the furnace, be quite cool, and at a suitable temperature for pouring a heavy casting, which ultimately turns out spongy, to the surprise of all concerned. In this case the melter has been too lazy or perhaps to ignorant to properly attend his furnace. He has allowed each successive charge of cold metal to wilt down and boil, before adding the next, this is a very common occurence, particularly where the melter has duties other than tending his fires. When the metal begins to melt it must receive constant attention. As fast as a charge gets red hot it should be pushed down into the liquid mass beneath, and cold metal filled in on top, until the pot is full, when it should be rapidly raised to the required temperature for pouring.

Prevention is better than cure. To prevent porosity melt carefully and never forget your charcoal covering.

Nuts for Rock Drills.

Question.—Could you give me a good mixture for brass rotating nuts or rifle bar nuts? For such as are used in rock drilling machines, it requires something tough and hard enough to stand a good deal of wear. The nuts are 2½ inches long and 2¼ inches outside diameter, with a thread cut on the outside, and the inside cored out with three spiral grooves fitting the rifle of the bar. All the strain and wear come on the three projections on the inside, and the rifle bar, which works through the nut, has an 8-inch stroke and makes 1-6 of a revolution each stroke. The drill makes 175 strokes per minute. From this, you can see that it requires pretty good material to stand the racking.

Answer.—Try the following:

Cu	80	pounds
Tin	9	"
Zinc	2	"

Core Binder.

Inquiry.—Can you please give a mixture of sand binder for making cores for small brass castings which would not require venting.

Answer.—Glue is a good binder to use for such cores.

Grinding Wheel Insurance.

The Pike Mfg. Co. of Cortland, New York, has introduced something which is rather an innovation in the grinding wheel trade, that is, the insurance of all of the Pike corundum wheels. Each one of the wheels belonging to this class has a certificate attached to it, which insures the operator against injuries sustained through any defect in the wheels.

Insurance and Liability Statistics.

The Department of Commerce and Labor, Washington, D. C., is preparing a report, covering the various systems of workmen's insurance and employes' liabilities, both in this country and abroad, and wishes to obtain information concerning all sickness, accident, disability, old age or death benefit associations or societies, either carried on by the employes of companies, or maintained by the companies themselves. They request that anyone having information upon this subject communicate with the department of Commerce and Labor.

THE PATTERN SHOP

A NINE-FOOT VALVE.

BY ROBERT SHIRLEY.*

The power plant of the Ontario Power Co., at Niagara Falls, Ontario, Canada, is situated at the foot of the Horse Shoe Falls on the Canadian side. The water for the wheels is led down to a point just below the falls in a pipe 18 feet in diameter. From the 18-foot pipe 9-foot pen stocks descend to the turbines, each of which is directly connected to a dynamo capable of generating 10,000 horsepower. For controlling the flow of water to the turbines it is necessary to introduce a valve in a 9-foot pen stock and the accompanying illustrations show the method of making the pattern and the mold for these valves. The work was done by the Pratt & Cady Co., of Hartford, Conn.

Each one of the gate valves weighs 126,000 pounds, and they are the largest valves thus far constructed. The complete valve assembled on the floor of the shop is shown in Fig. 1, which also shows the gears for the controlling mechanism, which is operated by electricity. The body of the valve on the cars ready for shipment is shown in Fig. 2, and this view gives a very good idea of the size of the pieces and the ribbing of the castings. For turning the circular portion of the pattern a regular Fay & Scott lathe was used,

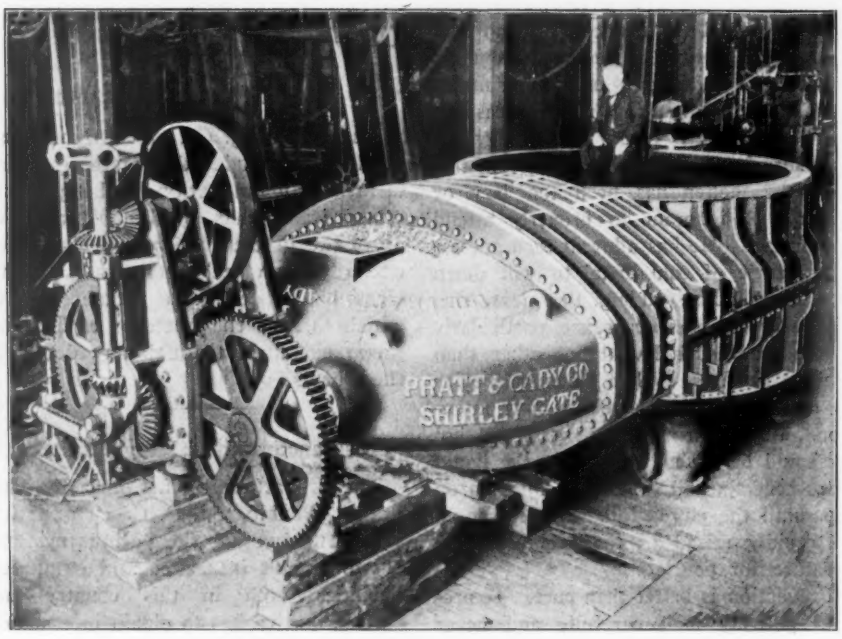


FIG. 1.—THE FINISHED VALVE.

*(Mechanical engineer for the Pratt & Cady Co., Hartford, Conn.)

FIG. 3.—THE PATTERNMAKERS.

which was built to swing 66 inches over the gap in the bed, but as some of the pieces were 132 inches in diameter, it was necessary to turn the head around and raise it 20 inches. The head was raised to save cutting a hole in the pattern shop floor. The chuck used in turning the work was the large iron chuck furnished with the lathe, to which a wooden face plate is attached. The lathe, together with a group of the patternmakers, is shown in Fig. 3, the piece of work in the lathe being a part of one of the valves. Mr. Peter Williamson, foreman of the pattern shop, is shown standing at the right of the picture. At the left of the picture can be seen the slide rest which was used in turning the various parts. The regular longitudinal slide rest which goes with the lathe was erected on a temporary wooden frame and performed its work admirably. A drawing of one-half of the valve body is shown in Fig. 4. The location of the ribs can be very plainly seen. The body was made in halves so as to leave its own core, with the exception of the internal ribbing, which was taken care of by dry sand cores. The horseshoe shaped flange A, which is located at the center of the valve, was made as a foundation upon which to build the pattern. The drum of the body was next turned up and placed in position at the circular end of the horseshoe

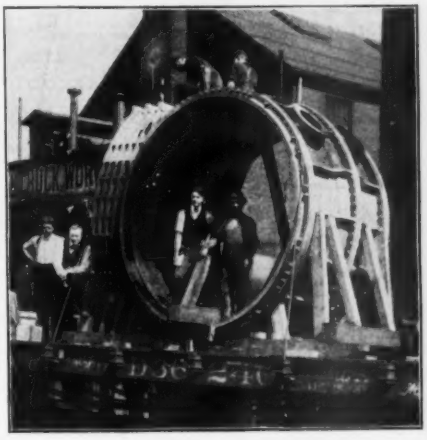


FIG. 2.—THE VALVE BODY.

shaped flange. The flange B was cut out on the inner side to conform to the shape of the outside of the valve body

or neck of the valve and was then placed in position. Staves were carried from the neck flange to the drum of the valve and made fast there. This gave the outline of the valve body. The outside ribbing was then put on over

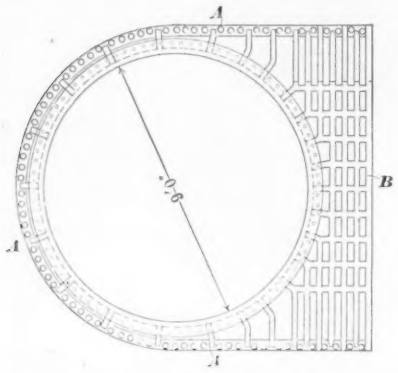


FIG. 4.— DRAWING OF VALVE BODY.

the staves and made fast by screws from the inside. The ribbing was also all fastened together, so that it could be drawn from the mold as one piece. The valve was molded with the round flange down. The sides forming the body or neck of the valve were so located that one came under each rib, as indicated by the dotted lines on Fig. 4 This left a space between the ribs so that the molder could ram down between them and secure each pocket as he went along. The annular flange was made in sections so that it could draw in after the pattern had been drawn from the mold. These sections were also screwed firmly in place while the mold was being rammed up on the outside. Before the inside of the mold was rammed up all screws were removed, both from the ribbing and the circular flange. A plate which had been previously prepared to carry the prints for the inside pocket cores was then put in place, all of the prints on the plate were numbered and the cores numbered to correspond. This was done to facilitate setting the cores and to avoid mistakes in the foundry. The prints were all put on with dowel pins so that they came away with the cope, thus leaving the mold free to be dressed.

After the pattern was drawn, (the inside of the ribs conforming to the outside of the body) all that was necessary was to scrape off the superfluous sand to the level of the ribs and the inside core gave the required thickness of metal.

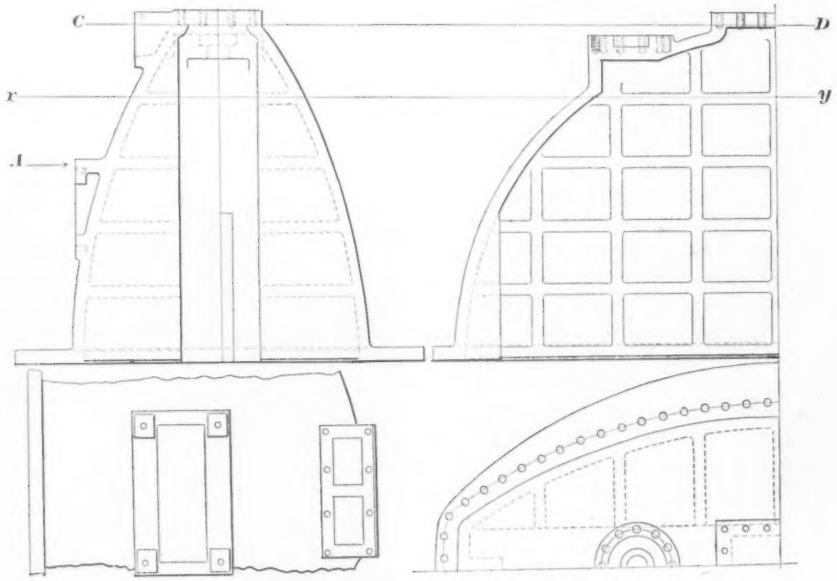


FIG. 5.—SECTION OF VALVE BONNET.

The general construction of the valve bonnet can be seen by referring to

FIG. 6.—MOLD READY FOR COPE.

Fig. 5. The bonnet was made in green sand with a dry sand core. The pattern was made as though it were expected to leave its own core and the interior of the pattern then used for a core box. This was done to save the expense of making a core box. The dotted lines below the upper right hand view in Fig. 5 show the print that was fitted into the bonnet when it was used as a pattern, also the corresponding piece which was fastened by pins to the flange of the bonnet when the pattern was used as a core box. By this device the core was made to fit the prints. In making the core the pattern was set on a cast iron plate. The top part of the pattern was made with a joint on the line XY, so that the upper part could be removed. This provided ample room for a man to work inside.

The inside ribbing was all made in separate pieces, and before the core was rammed up all the pieces except the bottom longitudinal ribs and the first row of the vertical ribs were removed. The sand was then rammed to the top of the vertical ribs, scraped off flush, and the second set of longitudinal and vertical ribs screwed in place, when the ramming proceeded as before. This continued until the line XY was reached. The top part of the bonnet was then replaced upon the pattern, being guided in place by dowel pins. The cap above the line CD was then removed, thus providing ample room for ramming up the top part of the core. The screws holding the various ribs in place were then taken out and the pattern lifted off. As the ribs were withdrawn from the core the recesses formed were filled with black sand to prevent the sagging of the box. The core was then ready for drying.

The greatest possible amount of care was taken in the pattern shop to avoid mistakes in the making of the various patterns required for a valve of this size, and the results were very successful and satisfactory.

Casting the Valve.

As has already been stated, the valve body was made in two parts, which were bolted together at the center. This body is heavily ribbed both inside

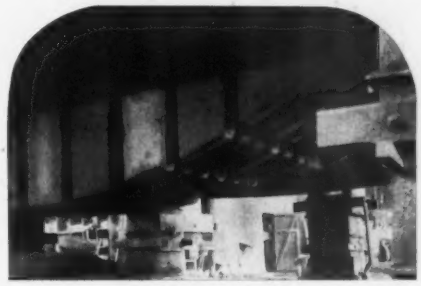


FIG. 7.—COPE AND CORES.

and out and hence it is a very delicate piece of work for the foundryman. A view of the mold for one-half of the body is shown in Fig. 6. A large central core is nine feet in diameter, and both the core and the mold are of green sand. After the pattern is drawn the central core, which is made on a plate, is removed to permit the proper dressing of the mold. As the mold is made in a pit in the floor the only rigging

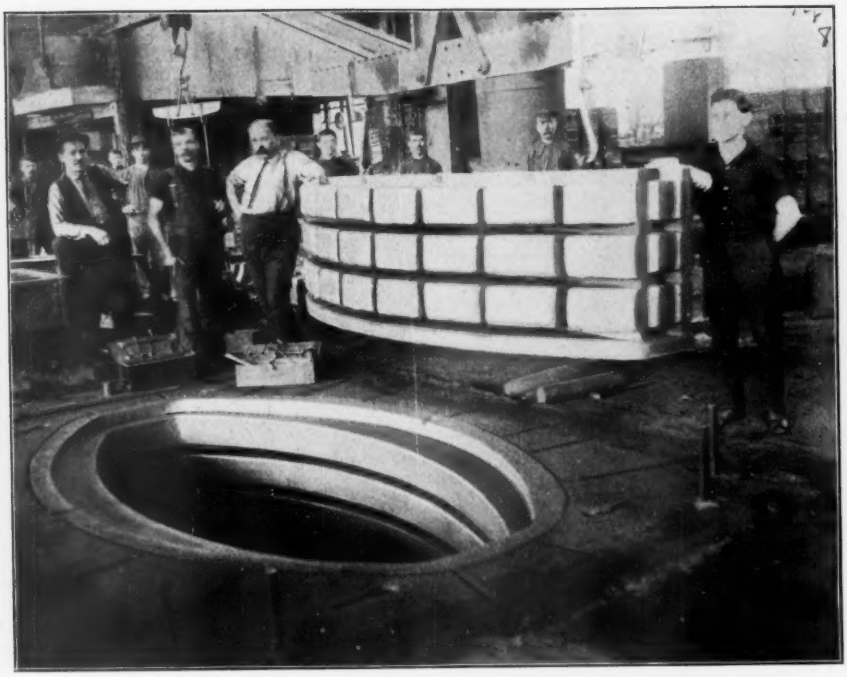


FIG. 8.— MOLD AND CORE FOR BODY EXTENSION OF VALVE.

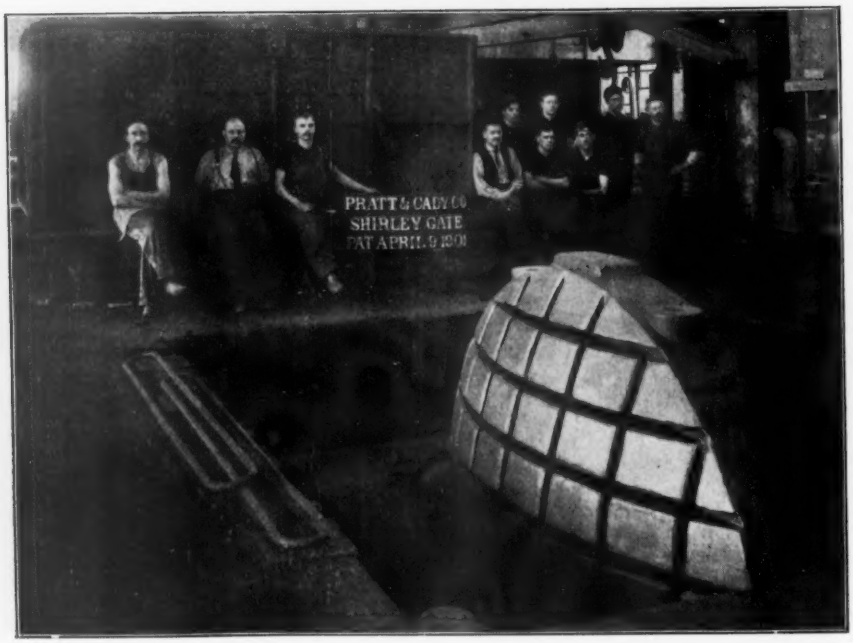


FIG. 9.—MOLD FOR VALVE BONNET.

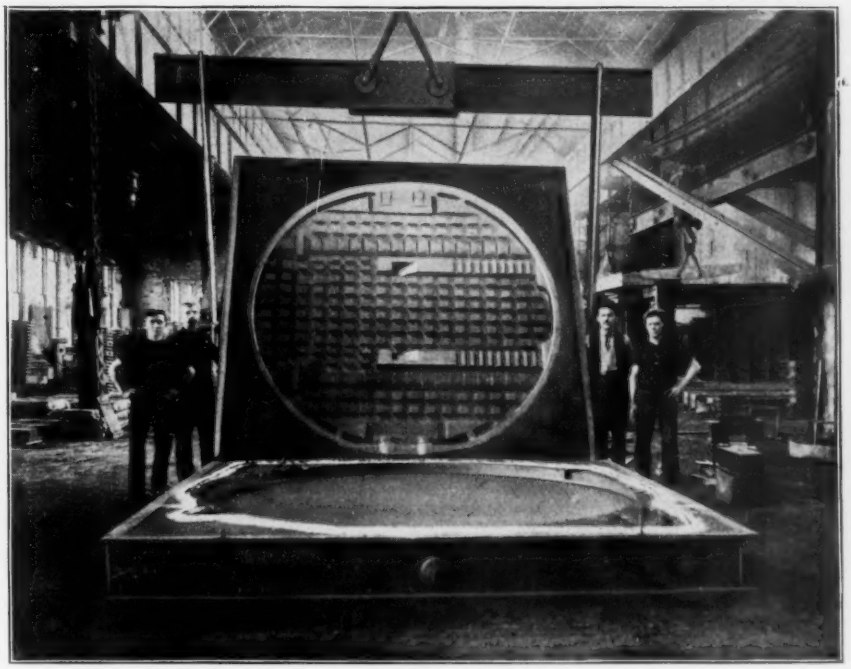


FIG. 10.— THE MOLD FOR VALVE GATE.

necessary was a plate for lifting the core and a flask for the cope. The rib pockets in the drag, being of green sand, were all securely rodded. The rib pockets in the cope were a much harder proposition to handle and hence were made with dry sand cores which were tied in place in the cope. Every print and every core was numbered to facilitate the setting.

Some idea of the complicated mass of cores on the under side of the cope may be had by looking at Fig. 7, which shows a view of the under side of the cope as it was suspended above the foundry floor. The cope with all of its cores in place weighed about 35 tons.

The mold for one of the distance pieces for the throat of the valve is shown in Fig. 8. This piece is also called a body extension. The mold is of green sand and the picture was taken just as the dry sand core was about to be lowered into place. On the right side of the picture is Mr. John Wusch, foreman of the foundry, and on the left of the core Mr. Edward Mullhouse, assistant foreman.

The pockets in the core are very deep and hence considerable care had to be taken in drying to prevent them from sagging.

The mold for the valve bonnet is shown in Fig. 9. The drag is made in a pit, and in the illustration a dry sand core is shown in place. The flask upon the lower flange of which the men are seated is the cheek. It was impossible to get a view of the inside of this part of the mold. The cope is not shown in the picture.

A view of the mold for one of the gates is shown in Fig. 10. The face side of the gate is in the drag to insure a good clean surface for the reception of the brass seat rings. The cope of this mold contains 190 dry sand cores. Absolutely no leeway is allowed in the making of these castings and if they had not come out straight they would have been rejected. When it is considered that the gate is 115 inches in diameter, the difficulty of the task of producing a perfectly straight casting will be readily appreciated by all foundrymen. Mr. Busch, however, gave the work his careful personal attention from the start and every casting came out perfect.

AN ECCENTRIC SPINDLE COLLAR.

BY H. J. MCCASLIN.

The accompanying illustrations show an eccentric collar applied to an ordinary foundry spindle for sweeping up circular molds. This is especially adapted to the sweeping up of circular work that is cast in halves, the mold being divided or separated by what are termed splitting cores. To split such work usually necessitates the shifting of the spindle a distance equal to the thickness of the splitting core used. This is often an awkward operation owing to the fact that the adjustment must be made below the floor level. The collar under description avoids such trouble very nicely, the piece is bored out and turned up as shown in Fig. 1 with any desired throw. The center line AA should be scribed distinctly across the face of the collar.

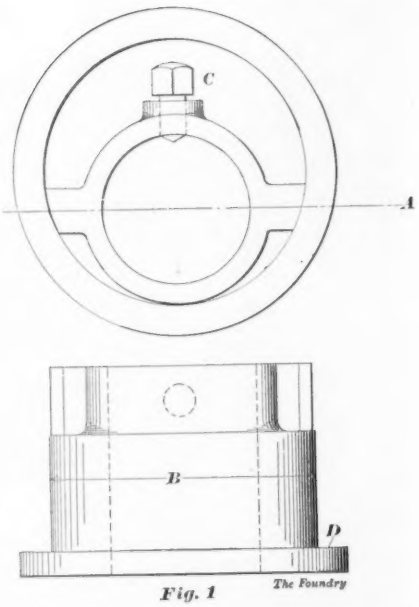


Fig. 1

This device is especially adapted for the molding of sections of gears, etc., where a section of the rim or a segment is used in ramming the outside diameter as shown in Fig. 2. To adjust the collar to the arm of the rim or segment a hole is cut at the exact center of the work, the diameter of the hole being sufficient to receive the portion of the collar marked B, Fig. 1.

The spindle is first set and plumbed in the usual manner. The collar is then slipped over it and secured by the set screw C at about the right height from the bottom. The arm with the segment attached is now let down over the spindle and centered upon the collar which holds it in the proper position

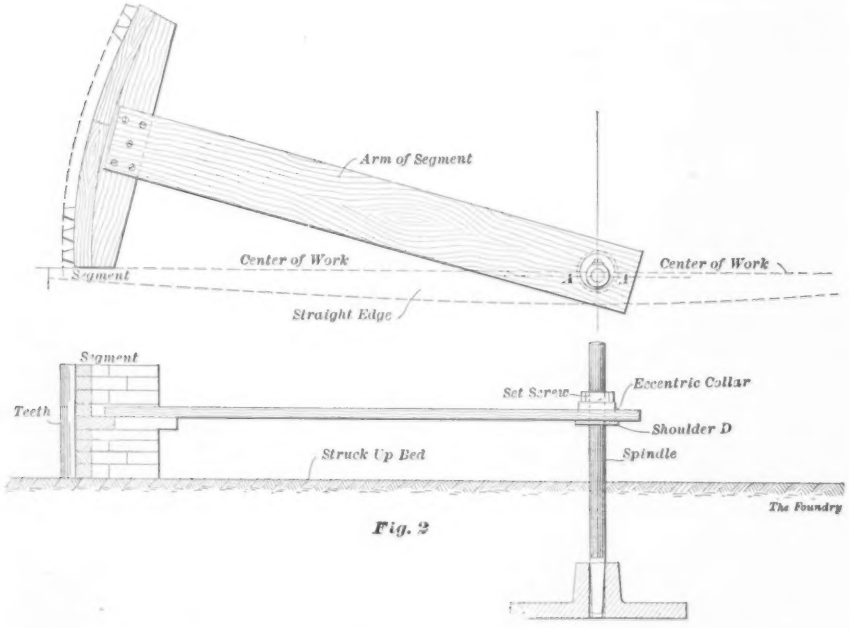


Fig. 2

and allows it to revolve upon the shoulder D.

As is the general practice, the segment is first set around the entire circumference, using flour to mark the correct position and spacing. When the spacing is found to be correct, a straight edge is placed across the center of the mold, as indicated by the dotted lines in Fig. 2. At the center the straight edge is cut out to receive one-half of the collar at the diameter B as shown. This brings the front edge of the straight edge in line with the center of the gear and locates the stopping point in ramming up this half of the wheel. Care should be taken in laying off this center line to see that it is parallel with the center line AA of the collar.

After one half of the mold has been rammed up the center line AA is marked on the spindle and the collar given a half revolution. The other half of the mold is rammed up just like the first half, care being taken to see that the space allowed for the spacing cores is equal on the two sides of the mold.

CLEVELAND CLUB ASSOCIATED PATTERNMAKER FOREMEN.

The patternmaker foremen held a meeting on Monday evening, February 19. After the transaction of the regular business the coming convention of the American Foundrymen's Association was discussed at length. Several of the members of the club expect to prepare papers for presentation at the American Foundrymen's Association meeting and it was decided that it would be a good plan to get the papers into fair shape, read them at some of the meetings of the club, discuss them, and then revise them for presentation at the convention in June. One of the subjects which is to be taken up by the club for discussion, with the idea of presenting it as a paper in June, is pattern shop equipment, the idea being to discuss the matter fully and arrive at some conclusion as to the equipment necessary for pattern shops of various sizes and handling various classes of work, both heavy and large.

Mr. J. Nall presented a very interesting paper on Floor Molding. The paper was discussed by several members and is to be put in shape for presentation in June.

The next meeting of the club is to be held March 19, when the members expect to have a smoker, and probably something of a musical program in addition to the discussion.

ANNUAL MEETING OF THE AMERICAN FOUNDRYMEN'S ASSOCIATION.

The annual meeting of the American Foundrymen's Association is to be held in Cleveland the first week in June. The Associated Foundry Foremen will also hold their convention at the same time, several of the sessions being joint sessions and the excursions being participated in by both associations. At least one session is to be devoted to patternmaking. At present indications point to an exceedingly valuable meeting at which good papers will be presented, not only on foundry and patternmaking lines, but on accounting and other subjects which are of interest to the foundryman, foundry foreman and patternmaker.

At the annual meeting of the Forsythe Pattern Co., of Youngstown, O., the following directors were elected; John Gallagher, George Rudge Jr., William Rudge, Frank Runser, and W. H. Park. William Rudge was chosen manager. Mr. Rudge was formerly connected with the company, but has been located in Cleveland for some time.

The Riverside Foundry & Machine Works, of Riverside, Cal., which were destroyed by fire last October, are being replaced by a new plant located on a site where better railroad facilities can be obtained. The main foundry building is 40 x 60 feet, with one wing containing a brass foundry and core ovens and another for a cupola building. The machine shop is 40 x 120 feet and is arranged at right angles to the foundry, there are also a pattern storage building, an office building and sheds for the storage of coke and supplies.

METALS IN FOUNDRY PRACTICE

Devoted to inquiries from Practical Foundrymen on subjects relating to the Melting and Using of Cast Iron, Malleable Iron and Steel.

The following experts answer questions in this department:

W. J. Keep, Cast Iron.

J. B. Nau, Metallurgy of Steel and Steel Castings.

Dr. Richard Moldenke, Malleable Castings.

We have also made arrangements with several others to act as special contributors. All inquiries should be addressed to the Editor of THE FOUNDRY, and they will then be forwarded to those in charge of the different subjects.

CAST IRON NOTES.

BY W. J. KEEP.

HARDNESS OF A CHILLED SURFACE.

About once in so often this question comes up. Not long ago two different makers of corn grinding mills reported that white iron run against a chill was so soft that it could be dented with a hammer. The trouble was that they used a non-chilling white iron and the remedy was to abandon this and use scrap plow points or scrap car wheels. Now comes a question as to the actual hardness of the portion of a gray non-chilling iron that was run against a chill. Several samples were tested on Keep's hardness testing machine.

The fracture of the one-inch square test bars with one side cast against a chill showed a white surface from 1-32 to ⅛ inch thick. Immediately under this was a very dull dark portion, with very close grain, about ¼ inch thick.

Then the grain changed suddenly to an open bright gray grain, which was uniform throughout the rest of the test bar.

The test showed the bright gray portion to be of a uniform hardness. As soon as the drill came to the black portion the diagram bent suddenly and was a perfectly straight line clear through the white skin.

Whether the drill started through the white skin or from the unchilled side the white part was not any harder than the soft dull black portion under it.

If a hard skin was required a portion of the mixture should be chilling iron such as car wheel scrap.

The writer discovered (Transactions A. I. M. E., 1888 and 1889) that chilling the surface of a non-chilling cast iron turned the iron under the chill a dead black.

A few years later an English chemist, Mr. Hogg, found that there was more graphite and actually more carbon in this black chilled portion than in the part that cooled naturally.

The test for hardness could not be made until the above machine was put on the market and no one supposed that the white chilled skin was as soft as the black portion.

The next determination will be the exact chemical composition of the white soft skin. And then whether the skin adds strength as with malleable iron.

MIXTURE FOR SAND ROLLS.

Question.—I wish to ask for information as to a mixture for rolling mill rolls. These are not chilled but must be hard and very strong to withstand a great strain. They are about 16 inches diameter by 6½ feet long with 7 or 8-inch neck 18 inches long on each end. They are used to roll out wrought iron bars up to three inches square and if they break it entails a big loss on the company. The irons we have are:

Salisbury	silicon	.75 %	sulphur	.08 %
"	"	.96 %	"	.04 %
Scotch	"	1.914%	"	.032%
"	"	1.641%	"	.030%

Several other grades silicon 1.97 per cent to 3.71 per cent. Sulphur 0.005 per cent to 0.027 per cent.

Please give me what information you can, particularly in regard to Salisbury and what proportions to use.

Answer.—As the question does not tell whether the iron is to be melted in an air furnace or in a cupola or whether the rolls are to be cast horizontally or on end and as there is not time to procure this information the answer will necessarily be general in character.

The composition of the sand roll mixture made by the American Foundrymen's Association Committee was silicon 0.72 and sulphur 0.07.

If the second brand of Salisbury iron was melted alone in a cupola with good fuel it would probably give this composi-

tion, but it would be too expensive a mixture, besides cupola melted iron would hardly be strong enough for such rolls. The other kinds of iron contain too much silicon.

The rolls should be cast on end and by a founder who has had experience because, aside from the composition, the physical structure of the surface and of the necks is of the greatest importance.

The only way to get satisfactory iron as to composition and strength is to melt it in an air furnace in which the silicon can be brought to the desired percentage and the sulphur can be kept uniform.

In such rolls the question of sulphur is very important as the surface of the rolls is exposed to sudden and very great changes of temperature and a small variation in sulphur will result in surface cracks during use which will in a short time destroy the roll.

As a general thing a roll maker is required to guarantee his rolls to do a given quantity of work so that the loss occasioned by a poor roll is a great loss to both founder and mill.

For this reason roll making is a business by itself and nearly all mills purchase from such founders.

MALLEABLE CAST IRON NOTES

GATING MALLEABLE CASTINGS.

Inquiry.—In the October issue of THE FOUNDRY there was an article, signed by Jean P. Fernal, entitled "Gating Malleable Castings," concerning which we would like to ask a few questions. The author states that he knows at least one plant where castings are made weighing 2,500 pounds. Could you inform us what class of goods this might be and whether any particular composition of metal is necessary for such heavy work? Also please give us approximately the thickness of the metal. Regarding the pattern question, the author puts special stress on the point of choking the gate before the feeder is reached. We will be very much obliged to obtain a rough sketch of a pattern gated in this manner.

Answer.—In reply to your inquiry concerning the gating of malleable castings, I am sending some sketches which I think will be plain to any foundryman.

Figs. 1, 3 and 4 show the general principle of two of our most common gates. Fig. 2 illustrates the patented gate, known

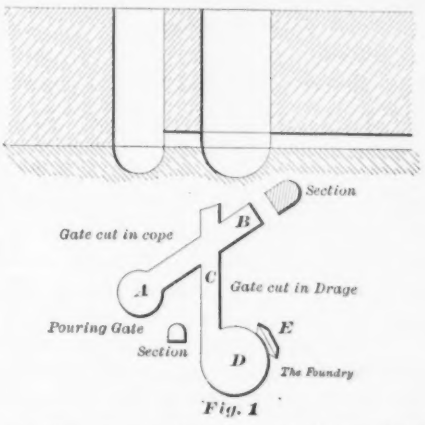


Fig. 1

as the cross gate, in which the iron striking the circle of the core is given a whirling motion, and throws the dirt up into the storage gate. The clean iron flows under the core into the feeder, through which it enters the casting. We do very little feeding directly on top of the casting.

To explain: In the gate shown in Fig. 1, the iron is poured down through the cope in the gate, and forces the dirt along into the point B. The clean iron flows through the gate C, entering the feeder D with a whirling motion, and thence flows into the casting. The gate AB is cut in the cope, the gate CD is cut

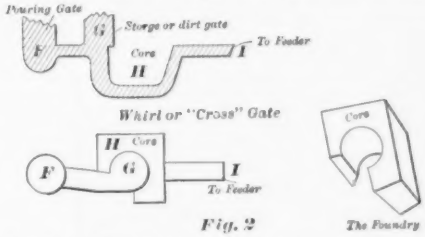


Fig. 2

in the drag. Care should be taken to have the area of AB nearly double that of C, in order to choke gate C. The patented gate shown in Fig. 2 has been described above.

The gate shown in Fig. 3 is simply a double whirl gate. The iron is poured through the gate J, flows through the two gates KK to the feeder, L, thence to the casting.

Fig. 4 shows a plain single whirl gate, in which the iron is poured through N, flows to O, where it whirls the dirt going up through O to the top of the cope. The iron flows through the bottom of O to P, where it also has a whirling motion before it enters the casting.

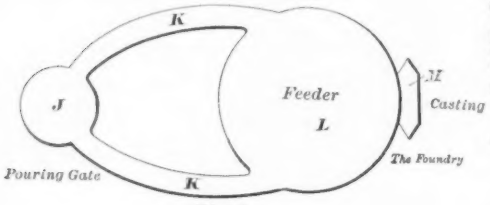


Fig. 3

In all cases, we either drive the dirt into the end of the gate, as at B Fig. 1, or give it a whirling motion, and drive the dirt through to the top of the cope, as at G Fig. 2, and L Fig. 3, or P Fig. 4.

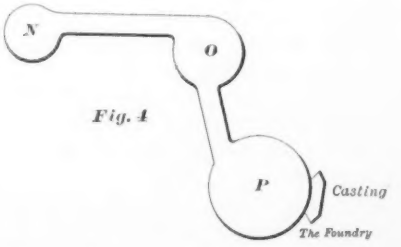


Fig. 4

Concerning our malleable casting referred to, I am enclosing a drawing, showing a cross section of one casting. The castings were in the form of rings about 7 feet in diameter, and the actual weight ran from 2,590 to 2,610 pounds each. There were four of the castings

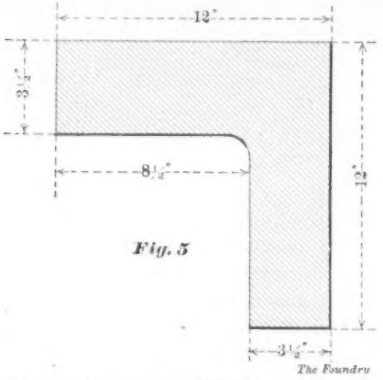


Fig. 5

made on the order. The iron was refined to a more marked degree in the air furnace. In casting these, we used four feeders. The feeders were about 3 feet high and from 12 to 14 inches in diameter. They were not placed on top of the casting, but inside of the ring, and were attached to the casting by gates from 4 to 6 inches square. The iron was run into the casting through the feeder gates, being gated on the parting line between the cope and drag, directly from two upright gates with runners through the cope. Hot iron was poured into the feeders, after the casting was full.

I trust that this makes the matter sufficiently clear to the inquirer.

JEAN FERNAL.

A STRIPPING PLATE MOLDING MACHINE.

A stripping plate molding machine having some special advantages is shown in the accompanying illustrations. The machine is of the ordinary stripping plate type and is entirely incased iron. This has two advantages:

PATTERN UP READY FOR THE FLASK.

First—All of the moving parts are protected from dust, dirt, sand, etc.

Second—When using a machine on heavy working and deep draws, the machine, mold and all can be rolled over and the pattern drawn up out of the sand. In such a case as this the iron casing protects the working parts of the machine from injury by accidental blows.

The pattern plate is carried on two crossheads wholly independent of each other. This is an important feature in adjusting patterns as it permits accurate setting of any piece upon the machine. The machine, however, is so constructed that the travel of the pat-

tern while it is being drawn is exactly vertical. The flask capacity of the machine is not limited to the distance between the guides or uprights but quite large flasks can be used on any of the machines. The same machines are also

PATTERN DRAWN.

built in the standard or open type, that is not "Ironclad." The machine illustrated is made by the Macphail Molding Machine Co., Davenport, Ia.

A NEW BOOK.

"Practical Patternmaking," by F. W. Barrows, New York. The Norman W. Henley Publishing Co. 7½ x 5 inches, 326 pages, fully illustrated. Cloth. Supplied by THE FOUNDRY at $2.00.

In reviewing this book, the editor read it through, and the further he got, the harder it was to decide what to say about the book, but, when turning back to the preface, the following words caught his eye: "I am not a believer in long distance instructions in patternmaking, or in any other trade, and. therefore, I don't expect, materially. to increase the number of competent patternmakers, by means of this book. I have been as concise in the statement of facts as possible, for the reason that these facts are, doubtlessly, known to many patternmakers, and any unnecessary elaboration would be a waste of time." He then goes on to acknowledge the fact that one of the principal objects of writing the book was to bring in dollars.

The book certainly contains a large amount of valuable information, written in a pleasing off-hand style, the heavier matter, relative to craft, being interspersed with anecdotes.

It is certain that the book was not written primarily to instruct the apprentices for there is no treatment of elementary patternmaking, nor the fundamental principles of patternmaking. For instance, the important question of shrinkage is not mentioned anywhere in the book. The statements concerning machine tools and their uses are to the point, but the subject is treated all too briefly.

The examples given in the latter part of the book include the making of patterns for pulleys, sheave wheels, chain-blocks, steam engine patterns, gear patterns, patterns for propeller wheels, globe valves and other examples.

One section of the book is devoted to the subject of metal patternmaking and contains a number of valuable hints and suggestions. The fifth part of the book deals with shop mathematics. The sixth part deals with cost of patterns and pattern records.

The best that can be said of the book is that it is another book on patternmaking which represents one man's experience, and should be in the hands of all progressive patternmakers, alongside of the well known books by Dingey and Case.

THE USE OF POWDERED FLUOR SPAR.

BY A. F. GRINDER.

Powdered fluor spar is a product made by grinding fluor spar to an impalpable powder. Material ground in this manner is suitable for a flux for cleaning any brass or bronze while in a crucible or in a reverberatory furnace, but there is another use to which it may be applied very advantageously, and that is, it may be introduced through the tuyeres of a cupola when the latter shows signs of stopping up. The fine powder will be blown directly into the melting zone and there unite with the partially fluid slag, rendering it fluid and clearing the cupola very quickly. Fluor spar has been used in this manner in blast furnaces very successfully.

THE FOUNDRY

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TRADE OUTLOOK.

As spring approaches the outlook for the summer's work is good. Most of the foundries have a large number of orders on hand which insure steady work at fair prices. One thing which marks this season is that neither the prices obtained by the foundrymen for castings nor the prices paid for raw material have been excessive. If anything, the prices received for castings have not advanced to the extent of those paid for raw material, and, as a consequence, careful work on the part of foundrymen is necessary if a profit is to be made on the year's business.

Prices for pig iron for No. 2 foundry remain as last month, $14.00 Birmingham being the quotation on No. 2 foundry iron for the southern field and about $17.25 for No. 2 foundry at valley furnaces in the north.

One point that is worthy of note is that the demand is not increasing, while the supply is increasing on account of the fact that more furnaces are going into blast, especially in the south. This increased supply will not show itself for some time on account of the fact that the stocks in the furnace yards have been and are still decreasing. The stocks of low grade irons, however, have been increasing lately, and these can be obtained at lower prices. For this reason foundrymen who mix by analysis can take advantage of many bargains which can be worked into good castings with a substantial profit.

SECRETIVE METHODS.

A few years ago, many things in connection with the foundry business were treated as profound secrets, which are, today, of common interest. The old method of determining the best alloys or the best iron mixture for any given case, was by experimental work, and each foundry guarded the results of its experiments carefully.

In the iron foundry practice, the mixing of iron by analysis, has done more to break down these old conditions than any other factor. But the

breaking down of these old barriers, and the bringing of the iron foundries into such a position that the foundrymen are glad to meet one another to exchange ideas and help each other, have resulted in putting the American iron foundry business far ahead of that of any other nation, so that, today, our iron foundries lead the world.

The introduction of machinery into the foundry has also been a matter in which the various foundry owners have been mutually helpful, and all have benefited in the process, so that the most progressive foundries are the ones whose doors stand widest open to all visitors, be they competitors or not.

It is strange, however, how little a competitor can really carry away in visiting a foundry. The greatest think that he carries away usually is an inspiration to do better himself, and while he may copy molding, rigging, handling appliances and many other matters, he still has to work out his own iron mixture, furnace practice, etc. This refers simply to visitors of foundries.

THE EDITOR'S TROUBLES.

Most people think that they have a corner on trouble, and that the worst variety always comes their way. The editor does not believe that he has any corner on this commodity—if commodity it may be called—but does wish that some of those who send in matter will remember that it is not always possible to recognize handwriting, and that it is pretty hard to give credit for an unsigned article.

Among the examples which might be cited is a case which occurred recently where someone sent the editor four very good photographs; two of them showing interiors of a brass foundry, one of a pattern shop and one of a pattern storage. He has no doubt that these were sent in answer to a request, but fails to recognize the plant, and as no writing whatever accompanied them it is impossible to use them at present, much as he would like to.

Frequently articles are received without signatures, letters of inquiry without local addresses, such as street and number, or post-office box and other similar errors. These errors result in many letters going astray and in some of our good friends blaming the editor for not answering letters, when either he had no address to send the letter to, or a poor address which resulted in the return of the same.

Another difficulty frequently met with is that someone will send in an article, and the illustrations under separate cover; the illustrations having no address or designating mark on them to couple them with the article. In many cases these are not referred to by figure number, and in some cases simply directed to the Penton Publishing Co., in place of to the editor of THE FOUNDRY. The result is a good many mixups concerning articles.

We hope that our friends and contributors will understand the friendly spirit in which the editor makes this growl and help him out by supplying complete addresses in all cases, and also that the good friends who sent the four photographs above mentioned, will see this and send along the additional information concerning them.

AN EXPLANATION.

The publisher of the *Metal Industry* has called our attention to the fact that the article published in the February issue of the THE FOUNDRY, upon "The Martin's Direct Rolling Process" was similar to an article by the same author which had appeared in that excellent journal and been copyrighted by them.

We wish to state that we have long been familiar with Mr. Martin's connection with the copper industry in Swansea, and had solicited an article upon some subject bearing upon this industry from him. He sent in an original manuscript and drawings from which the illustrations were made. We published it in good faith and paid Mr. Martin at our regular rates.

We are sorry that any misunderstanding has occurred on the subject, and would not think of using matter from our contemporary's columns without giving due credit.

ASSOCIATIONS AND SOCIETIES.

New England Foundrymen's Association

Fred F. Stockwell, Secretary, Care of the Barbour-Stockwell Co., Cambridgeport, Mass.

The regular monthly meeting of the New England Foundrymen's Association was held at the Exchange Club, Boston, Wednesday, Feb. 14.

Announcement was made that the March meeting would be held in Hartford, Conn., the arrangement being in the hands of the following committee: Henry Souther, of Hartford, Chairman, E. E. Durant, New Haven, Chas. J. Caley, New Britain, and Fred Strong, Bridgeport.

Appropriate resolutions upon the death of Michael J. Dyer, of Valley Falls, R. I., were adopted. President Snow reported the death of Mr. Frederick T. Towne, of Yale & Towne Mfg. Co. The chair appointed Messrs. Carpenter, Caley and Farnsworth a committee on resolutions.

The president then introduced Mr. J. S. Robeson, president of Robeson Process Co., Camden, N. J., who spoke on "Core Sands." Several samples of core sand were exhibited, also photo-micrographs showing the great variations in the size and proportions of the different sizes in the sands commonly used for core work.

The meeting adjourned to dinner at six o'clock, after which the president introduced as the speaker of the evening, Mr. Chas. Kirchhoff, editor of the *Iron Age*, who spoke on General Tendencies, Economic and Technical, which are Influencing the Development of the Manufacture of Pig Iron."

Philadelphia Foundrymen's Association

Howard Evans, Secretary, care J. W. Paxson Co

The February meeting of the Philadelphia Foundrymen's Association was held at the Manufacturers' Club on February 7. The meeting was devoted to the discussion of the foundry trade in that city. Notwithstanding the somewhat unsatisfactory labor conditions existing, it was reported that the trade was in excellent condition, with all foundries busy up to their capacity, and orders on the books for some time ahead.

A lunch followed the meeting after which brief addresses were made by J. H. Barlow, H. C. Tripple, W. O. Steel and others.

Pittsburg Foundrymen's Association.

F. H. Zimmers, Secretary, Care Union Foundry and Machine Co., West Carson Street.

The February meeting of the Pittsburg Foundrymen's Association was held at Hotel Henry, Pittsburg, Monday evening, Feb. 5. A large and representative attendance of foundrymen was present and after the banquet, which will hereafter be a feature of the monthly sessions, William A. Bole, shop manager of the Westinghouse Machine Co., East Pittsburg, and Dr. Richard Moldenke, secretary of the American Foundrymen's Association read papers on foundry practice. These were followed by an extended discussion on the many points brought out in the papers and particularly upon the use of aluminum in foundry practice and losses sustained by foundries in the operation of their plants, these losses applying to loss of metal in melting and molding. At the March meeting of the association Mr. H. E. Field, of Mackintosh, Hemphill & Co. will read a paper on "Amount of Loam and Clay Required in Molding Sand." Secretary Zimmers announced that the April meeting will take the form of a banquet and reception to the Philadelphia Foundrymen's Association and the New England Foundrymen's Association and a special committee composed of W. H. McFadden, of Mackintosh, Hemphill & Co., A. V. Slocum, of the National Car Wheel Co., and F. M. Zimmers, of the Union Foundry & Machine Co., was appointed to take charge of the affairs. A vote of thanks was tendered to Messrs. Bole and Moldenke for their papers.

Paul Preuzpointner, of Altoona, Pa., in an address spoke of industrial conditions abroad, particularly as they applied to American competition, went extensively into the trade and industrial schools abroad and advocated their

more general adoption or establishment in the United States. He paid a high tribute to the Carnegie Technical Schools.

Buffalo Foundrymen's Association.

John E. Gorss, Secretary, 23 Builders' Exchange.

The annual meeting and election of officers of the Buffalo Foundrymen's Association, took place at its headquarters, 685-691 Ellicott Sq., Jan. 16. The following officers were elected for the ensuing year: President, Lyman F. Hubbell; vice president, Wm. H. Barr; treasurer, Geo. M. Trefts; secretary, John E. Gorss. Executive committee: Lyman P. Hubbell, Wm. H. Barr, T. L. Richmond, Edward Kener, Jr., and H. D. Miles.

The reports of the treasurer and secretary showed that the association is in a very prosperous condition, with a membership of 36 foundry firms and 4 applications to be acted upon at the next regular monthly meeting.

The attendance at the meetings during the year, has averaged 90 per cent. Twenty-two of the members are affiliated with the National Founders' Association. The members are especially interested in the employment department feature of the association. Many of the firms give employment only to those who are recommended by the bureau.

Cleveland Foundry Foremen.

H. M. Lane, Browning Bldg. Secretary.

The Cleveland Foundry Foremen held a meeting on January 20, at which the regular routine business was transacted, and several new members were elected. After this, Mr. E. D. Frohman, of the S. Obermayer Co., presented a very interesting paper on "Core Sand and Core Binders." The paper was followed by a discussion, in which a number of foundry foremen took part.

A second meeting was held on February 3, at which Mr. J. Murphy, of the Interstate Foundry Co., of Cleveland, presented a paper on "Fillets," which was discussed, to some extent.

Both the meetings were fairly well attended, and everything points to a very successful series of meetings throughout the spring.

NEWARK FOUNDRYMEN'S ASSOCIATION.
H. L. Gebhard, Secretary, 36 Francis St.

THE ASSOCIATED FOUNDRY FOREMEN.
Frank C. Everitt, care the J. L. Mott Iron Works, Trenton, N. J., Secretary.

NEW YORK FOUNDRY FOREMEN'S ASSOCIATION.
C. H. Thomas, 14 Elizabeth St., So. Norwalk, Conn., District Vice President.

ERIE FOUNDRY FOREMEN.
W. F. Grunau, Dist. Vice Pres., care Erie City Iron Works.

CHICAGO FOUNDRY FOREMEN.
Mr. Thompson, Link Belt Co., District Vice Pres.

MILWAUKEE FOUNDRY FOREMEN.
Sol. Shaw, care Clinton Street Foundry of Allis-Chalmers Co., Secretary.

CINCINNATI FOUNDRY FOREMEN.
E. W. Cadwell, Secretary, care S. C. Tatum Co.

INDIANAPOLIS FOUNDRY FOREMEN.
W. S. Keller, of Hetherington & Berner Co., District Vice President.

HAMILTON, ONT., FOUNDRY FOREMEN'S ASSOCIATION.
A. Chase, care Sawyer & Massey Co., Secretary and Treasurer.

PHILADELPHIA FOUNDRY FOREMEN.
W. P. Cunningham, American Bridge Co. Sec'y

MONTREAL FOUNDRY FOREMEN.
Mr. J. F. Gaffney, care of Allis-Chalmers Bullock Co.

MAGNETS FOR UNLOADING PIG IRON.

At the Buckeye Engine Works, Salem, O., there is installed an electric magnet which will unload a carload of pig iron in three hours with one man in the crane only. Bins have been arranged for receiving the iron so as to prevent having to make even piles. When unloading the metal by hand it took six men six hours to unload a car.

DEATH OF FREDERICK T. TOWNE.

Frederick T. Towne, superintendent of the Yale & Towne Mfg. Co.'s plant at Stamford, Conn., and son of Henry R. Towne, president of the company, died early on the morning of Sunday, Feb. 4. The day before, at the close of an address to the employes of the company on the occasion of a semi-annual distribution of $1,200 offered yearly to the workmen for suggestions of benefit to the firm and its employes, Mr. Towne fainted. He never regained consciousness.

FREDERICK T. TOWNE.

Although only 34 years of age, Mr. Towne had made a name for himself in the industrial world. He was a member of the administrative council of the National Founders' Association from February, 1900 until November, 1903, during the last year of which time he served as president, although he was one of its youngest members. He was exceedingly active in its behalf and had much to do with formulating its policies.

Mr. Towne was a graduate of Tufts College. After completing his course there he entered the employ of the Yale & Towne Mfg. Co., speedily working himself up to the superintendency of its plants at Stamford and Branford, Conn., with 3,000 men in his control. It was his ambition to make the Stamford plant a model one, especially in the relations of employer to employes. So thoroughly were his efforts in this direction appreciated that flags on all the public buildings of his native town were at half mast on the day following his death. He was a member of the American Society of Mechanical Engineers.

Fred T. Towne had a remarkable character.

Only thirty-four years old, and yet he had for years done great honor to himself and his distinguished father, who had carefully trained him for the position of great responsibility which he so graciously and acceptably filled.

As superintendent of one of the very large manufacturing establishments of our country, he developed a measure of executive ability which inspired amazement in the minds of all those who were fortunate enough to be familiar with the character of his work. It has been said that but few business enterprises in America necessitate such close attention to a multiplicity of intricate details as the manufacture of such a complex line of locks and ornamental hardware of all kinds as are made by the Yale & Towne Co.

To have it said, therefore, that he was master of every detail of an executive and administrative character connected with the extensive works at Stamford, is of itself no small compliment; but to add that at his early age he had inaugurated reforms and installed improvements and systems of a far-reaching scope, carries with it its own commendation.

He had a peculiarly analytical mind and a rare ability to solve a complicated problem quickly into what seemed to be a simple proposition, unencumbered by unnecessary details. His judgment was invariably of the best and during the trying period of 1902 and 1903 when he presided over the

destinies of the National Founders' Association and frequently had to pass upon and decide embarrassing questions of policy involving vast interests, his decisions were never once questioned, nor was their wisdom found to be in error. Not alone did he command in no ordinary way the confidence and esteem of the large number of influential manufacturers who made up that association, but organized labor likewise, on more than one occasion, was influenced by his strong personality and sense of justice to take a conservative rather than a radical course.

As a loyal friend the world never produced his superior, and the enthusiastic devotion and admiration of the large circle who were honored by his esteem must always bear witness to his unselfishness and thoughtfulness whenever the interests of others were concerned.

Add to all this his peculiar charm of manner, his goodness of heart, strict integrity and indefatigable industry, and it is little wonder that he had achieved very early in life a national reputation that must be a fond heritage to his own family circle and those who in every part of the world knew him only to admire him.

DEATHS.

M. J. Dyer, proprietor of the Valley Falls Iron Foundry, of Valley Falls, R. I., died very suddenly December 29, 1905. Mr. Dyer worked as a molder for twenty-five years, and then started a foundry of his own, which has been very successful. He was 47 years of age, and by his kindness and willingness to help others had made many friends.

John Ryan, of the Union Brass Works, of Lowell, Mass., died suddenly on Jan. 3, after an illness of only two days, of appendicitis. Mr. Ryan, with his brother, conducted one of the largest brass foundries in Massachusetts. The two brothers served their apprenticeship together and afterward started in business together. Mr. Ryan was 36 years of age.

Frederick B. Burkhardt, a pioneer foundryman of Cincinnati, died Jan. 25, at the age of 77. He was born in Alsace, coming to America when very young, and serving as an apprentice at the Niles foundry, where he rose to the position of superintendent, which he resigned to associate himself with the Greenwald foundry. He superintended the construction of a number of the monitors for the United States government during the Civil War, after which he engaged for a time in locomotive building. He was a member of the firm of Fritsch, Burkhardt & Co., founders and machinists, but abandoned that business to devote himself to mercantile pursuits.

Henry Hill Sr., proprietor of the Oregon foundry, of Portland, Ore., died on Jan. 30 after a short illness. Mr. Hill was a pioneer Portland foundryman and well known throughout the surrounding region. His foundry was recently destroyed by fire and had just been rebuilt.

Alexander Jack, of Evansville, Ind., was found dead in his shop on January 8. His sudden death, which was due to heart disease, ended a long and busy life. Mr. Jack was born in Scotland in 1833 and came to this country at the age of 18. Shortly after the civil war he constructed an iron furnace for the Adra Iron Works, which were afterward sold to Gen. Buell. Still later he started the firm now known as the Mechanics' Foundry, of Evansville, but owing to business reverses lost his share in the business and later opened a small repair shop which he conducted at the time of his death.

PERSONALS.

Mr. John H. Regan, of Providence, R. I., has opened a new brass foundry in the rear of 18 Camp street. Mr. Regan has worked in different places in Providence for twenty-five years, and is thoroughly acquainted with the brass foundry trade. For ten years he was foreman for the Arlington & Sims Engine Co., of Providence, R. I.

F. I. Freeman, formerly connected with the Geo. A. Hogg Iron & Steel Foundry Co., of Pittsburg, has been appointed general superintendent of

the Vulcan Foundry & Machine Co., of Pittsburg, with works at New Castle, Pa.

R. H. West has resigned as superintendent of the foundry of the Mesta Machine Co., Pittsburg, to become superintendent of the Vandergift plant of the United Engineering & Foundry Co.

Mr. Joseph B. Vannan recently resigned his position as foreman of the foundry of Van Bergen & Co., of Carbondale, Pa., after a most remarkable career. He entered the employ of the company in September, 1849, and hence has spent 57 years in its service. For the last 22 years he has been foreman of the foundry, and was recognized as an efficient, faithful man. The management of the company has changed repeatedly during this time, but he has remained in the same position. The employes of the company presented Mr. Vannan with a gold-headed ebony cane, as a token of their esteem. As stated in THE FOUNDRY last month, Mr. Thomas Fox, who has been with the company for several years, will succeed Mr. Vannan as foreman.

F. M. Davis, of Denver, Colo., has retired from the active management of his plant. Mr. Davis went to Colorado in 1875 and purchased the Ensminger Iron Works for $1,200. The business was carried on for some time under the firm name of Ensminger & Davis. In 1891 the F. M. Davis Iron Works Co. was organized and has been very successful since that time. The management of the works has been transferred by Mr. Davis to his son, W. C. Davis. Mr. F. M. Davis expects to spend some time in travel and thus enjoy the competency which he has acquired.

Mr. J. W. Harrison, who has been superintendent and manager of the plant of the National Car Coupler Co., at Converse, Ind., for the past eight years, has been elected president and general manager of the company, to succeed Mr. Frank Nowak, who has resigned.

Wilbur H. Traver, who was for 12 years manager of the Chicago territory of the Rand Drill Co. until the consolidation of the Ingersoll Rand Co., when he was given charge of the railway department of the new company with headquarters in Chicago, has since severed his connection with that company, and accepted a position as manager of the mining and contract department of the Chicago Pneumatic Tool Co., Chicago, Ill. Mr. Traver will devote his time and attention principally to the sale of air compressors, rock drills, and mining machinery.

Herbert Kehler has been made superintendent of the foundry of the B. I. Holland Foundry Co., of Warsaw, Ind.

W. H. Marshall, general manager of the Lake Shore R. R. Co., has been elected president of the American Locomotive Co. The American Locomotive Co. operates a number of plants at different points in the United States and one at Montreal, Canada. These various plants are equipped with the very latest appliances and most of them are provided with foundries, some of the foundries being among the finest in the United States.

G. P. Bassett Jr., until January 1 Pittsburg resident manager for Rogers, Brown & Co., has established himself in the pig iron and coke brokerage business, with offices at 100 German National Bank Building, Pittsburg.

H. A. Forsyth, one of the best known pig iron salesmen in Chicago, has associated himself with A. H. Carpenter, the Chicago manager of sales of the Tennessee Coal, Iron and R. R. Co.

FIRES.

The pattern shop of the Carbondale Machine Co., of Carbondale, Pa., was damaged by fire to the extent of $10,000 on January 11.

The brass foundry department at the Vandalia shops in Terre Haute, Ind., was damaged by fire on Feb. 2 to the amount of $4,000, which is covered by insurance.

The foundry of Kerr & Coombes, of Hamilton, Ontario, was damaged by fire on Jan. 18. The loss is between $4,000 and $5,000. The principal damage to the patterns was from water.

The patternshop of the George A. Hogg iron and steel foundry, Pittsburg, was destroyed by fire Jan. 31,

when some costly patterns were burned. The loss is placed at $5,000.

NEW CONSTRUCTION.

The Hotchkiss Foundry Co., of Torrington, Conn., which was organized to manufacture builders' hardware, has built and equipped its plant, which is now in full operation.

Thomas Haley has broken ground for a new brass foundry on East Main street, Orange, Mass.

The Bridgeport Foundry Co., of Bridgeport, Conn., is constructing a new foundry building 50 x 100 feet.

John Rochester has taken out a building permit for a one-story frame foundry building, 60 x 80 feet, at the corner of Grand and Fulton streets, Richmond Hill, New York City.

Frank E. Wood, who has been employed by Powell Bros., at Shadeland, Pa., for several years, has decided to establish a foundry for himself in Girard, Pa. He has let a contract for a 2-story building 26 x 40 feet, and will start in the manufacture of patent novelty goods.

The Fort Pitt Steel Co., which recently applied for a charter, has leased a plot of ground at McKeesport, Pa., where a plant which will employ from 100 to 200 men will be erected. C. S. Koch, formerly with the American Steel Foundries, of Pittsburg, is one of the incorporators.

Charles Spangler, of Allentown, Pa., has recently completed a new foundry building of cement block construction.

M. J. Drummond & Co., proprietors of the North Reading Foundry, of Reading, Pa., have been given a permit for the construction of a foundry 50 x 71 feet.

The Union Foundry & Machine Co., of Johnstown, Pa., has its new plant in operation.

Metcalfe & Miller, builders of a well known type of gasoline engine, will build a foundry at Quincy, Pa., in the near future.

The firm of Barker & Son, of Scranton, Pa., is preparing to double the capacity of its foundry this spring.

B. Frank Harpel, who has been conducting a foundry and machine shop at Bernville, Pa., will move his plant to Topton, Pa. The contract for the new plant has been let, and the main building will be 75 x 100 feet.

The William Powell Co., of Cincinnati, O., expects to increase the capacity of its brass foundry plant during the next six months. The new building is to be a 2-story concrete and steel foundry building, 60 x 175 feet.

The Troy Foundry Co., of Troy, O., has just moved into its new foundry building.

The Hennessy Foundry Co., of Springfield, O., has taken out a permit to build a small addition to its plant.

Flum Bros., of Hamilton, O., have completed an addition to their foundry which has made it possible to add fifteen men to the force.

The business of the Shelby Foundry Co., of Shelby, O., has been increasing so rapidly that it is necessary to increase the capacity of its plant, and to accomplish this $2,500 worth of preferred stock has been issued, all of which has been taken up by the citizens of Shelby.

The Lima Locomotive & Machine Works, of Lima, O., will construct a new foundry building in the near future.

The plant of the Mason Heater & Foundry Co., of Bellaire, O., which has been idle for some time, has been reopened with a goodly stock of orders on its books.

The Indiana Foundry & Machinery Co., of So. Bend, Ind., is constructing an addition to its plant, 40 x 80 feet.

The Twin City Foundry, of Sterling, Ill., is building an addition to its foundry 30 x 30 feet to increase the molding floors. Williams & Owens are the proprietors.

The Peoria Brass Foundry & Heating Co., of Peoria, Ill., is planning to secure a new site with additional buildings for its plant.

The Moline Foundry Co., of Moline, Ill., has been so successful that it will be necessary to enlarge the plant to take care of the growing business.

The Farragut Foundry Co., of Chicago, Ill., has taken out a permit for a brick addition to its foundry to cost $1,500.

The New Jersey Aluminum Co., of Newark, N. J., is adding a new foundry to its present plant. The building will be 38 x 50 feet.

The Garwood Foundry & Machine Co., of Garwood, N. J., is having constructed an addition to its foundry 80 x 80 feet.

It is reported that the Mississippi Central Railway Co. will expend $100,000 in the construction of a modern plant for manufacturing cars at Hattiesburg, Miss. The plant will include a foundry.

The Coosa Pipe & Foundry Co., of Gadsden, Ala., reports that its business has increased so rapidly that it has become necessary to construct an additional building, 80 x 200 feet, thus doubling the capacity of its plant. The present daily capacity is 20 tons and the increased capacity will be 40 tons, and may be increased to 100 tons by the end of 1906.

The J. B. Westbrooks' Foundry & Machine Co. of Danville, Va., will double the capacity of its foundry, machine shop and freight elevator departments in the near future.

R. W. Whitehurst & Co., of Norfolk, Va., whose foundry was recently destroyed by fire, commenced rebuilding before the ruins were fairly cold. The new buildings will be entirely of brick and steel construction.

The Standard Sanitary Mfg. Co., of Louisville, Ky., has purchased property adjoining its plant and proposes to erect an office and storage building 80 x 135 feet and also a 2-story brick brass foundry.

The Norfolk & Western Railroad Co. is planning to add a foundry building to the railroad shops at Norfolk, Va.

The Atlantic Coast Line Railroad Co., of Wilmington, N. C., has prepared plans for new locomotive and car shops to be erected at Waycross, Ga. The plant will include all the departments usually connected with such works, among which may be mentioned foundry and pattern shops.

The Southern Railway shops at Spencer, N. C., will be enlarged in the near future, the improvements including a new foundry building.

The Nashville Machine Co., of Nashville, Tenn., has filed an application for an amendment of its charter to increase its capital from $50,000 to $100,000, in order to enable it to erect an addition to its plant to be used as a foundry. Other extensive improvements will be made.

The new buildings for the Waterman Car Wheel & Foundry Co., of Houston, Tex., are being pushed to completion as rapidly as possible.

The Olympic Foundry Co. has disposed of its property in Seattle, Wash., and purchased a site of three acres at Argo Station, Georgetown, Wash., adjoining the Northern Pacific tracks on the west. The work of constructing a new foundry will begin at once. The building will be 75 x 150 feet.

The Comanche Mining & Smelter Co., of Tres Piedras, Grant county, N. M., has established a foundry and machine shop in connection with the operation of its smelter.

The Canadian Rand Drill Co., of Sherbrooke, Que., is planning extensive improvements to its plant, including a new foundry.

Frazer & Jones have secured a site at Solvay, Syracuse, N. Y., upon which they will erect a number of buildings to be used for foundry purposes.

The S. B. Sexton Stove & Mfg. Co., Baltimore, has purchased property adjacent to its plant on W. Conway street and will probably erect two additional buildings.

The Vulcan Foundry Co., Hamilton, O., has occupied its new building which is 58 x 320 feet in size.

The new iron foundry at the Brooks plant of the American Locomotive Co., Dunkirk, N. Y., which is now nearing completion, covers a trifle more than 2 3-5 acres of ground. The main structure is 175 x 650 feet.

The American Radiator Co. has let contracts for a number of additions to its plant at Springfield, O. The machine shop will be extended by the erec-

tion of a two-story building 70 x 100 feet and the foundry by a one-story structure 60 x 100 feet. They will be of brick and steel construction.

The Hart Grain-Weigher Co., Peoria, Ill., has contracted for a new foundry building 50 x 132 feet.

The Crestline Mfg. Co., Crestline, O., manufacturer of brass goods, pumps, etc., will erect a building 40 x 100 feet to be used as a warehouse and for storage purposes, thereby giving more room for the manufacturing departments.

The Victor Safe & Lock Co., Cincinnati, is to erect a $250,000 plant on a site recently purchased in Norwood, a suburb, directly opposite the new plant of the Schreiber Iron Works. Plans are being prepared and building operations will begin as soon as the weather is favorable in the spring. The first building will be 100 x 400 feet, equipped for the manufacture of bank fittings. It is also probable that the completed plant will include a steel foundry and a mill for the making of plates and angles.

The Calumet & Hecla Copper Co. has completed plans for the erection at Calumet, Mich., of a large iron foundry on which work will begin with the opening of spring. Iron columns are being largely substituted for timber in underground work.

The Toledo Shipbuilding Co., Toledo, O., which recently purchased the Craig plant, is preparing plans for the erection as soon as contracts can be let of a four-story pattern shop 60 x 160 feet and a power house, 42 x 80 feet. Contracts will be closed about March 1 for a new dock 104 x 625 feet. These will complete the improvements to be made the present year, but plans include a number of large buildings to be erected the following year.

The Montford Machine Casting Co., Baltimore, is to increase the capacity of its plant by the erection of a new foundry 60 x 140 feet, another building to be devoted to shipping purposes, and a boiler and engine room. A cupola of from 8 to 10 tons' capacity will be installed. Contracts for the building have been closed.

GENERAL INDUSTRIAL NOTES.

The "M" Mfg. Co., of Watertown, Wis., has been incorporated with a capital of $25,000, by F. W. Menkey, F. W. Moldenhauer, H. R. Moldenhauer and Louis Dornfeld. It will carry on a foundry business.

The name of the Montrose Iron Works, of Frederick, Md., has been changed to the Frederick Iron Works, and the company has been re-organized with the following officers: Geo. C. Johnson, president; Thos. M. Dwen, vice president; Samuel Ross, treasurer, and K. Berle, secretary and general manager.

Western Foundry Supply Co., is the name of a firm recently organized to manufacture ferro-manganese, ferro-silicon, chrome ore, foundry facing, etc. Its headquarters are at East St. Louis, Ill., where its plant is located on the Terminal Railway Co.'s tracks close to the L. & N. Junction. H. Nixon, of St. Louis, is president and J. A. Rogers, secretary and treasurer. J. J. Mallonee, of Savannah, Ga., is a stockholder. A building 54 x 85 feet in dimensions and three stories high has been erected. The machinery consists of a 100-horsepower boiler, 80-horsepower automatic engine, one crusher, one pulverized, rock emery mill, French burr mill, toggle screens, elevating machinery, bolting rolls, etc., all of which has been bought and is being installed. The plant is equipped for a daily output of one carload of foundry facing. It will also have an output in addition of one carload per day of ferro-manganese or ferro-silicon which will be crushed to the requirements of customers. The company will also manufacture ground aluminum and at an early date contemplates placing on the market an alloy for use in gray iron foundries.

The E. Stebbins Mfg. Co., Springfield, Mass., has been sold by H. M. Brewster and associates to Frederick Harris, L. J. Powers, F. L. Chapin and A. H. Warner. The company is capitalized at $50,000 and employs about 150 men in the manufacture of brass goods. A. H. Warner will remain as treasurer

and E. P. Marsh as superintendent, the business being conducted along the same lines as heretofore. Maj. Brewster retires after a connection of 28 years with the concern.

The General Metal Mfg. Co., having plants in operation in Waterbury and Bridgeport, Conn., is considering the establishment of another plant at Scranton, Pa., and has obtained an option on the works formerly occupied by the Scranton Nut & Bolt Co. The company manufactures a line of specialties in brass.

The Eastman Car Co., of Portland, Me., has voted to increase its capital stock from $80,000 to $90,000.

The Pacific Mfg. & Supply Co. has been organized in Spokane, Wash., with a capital of $50,000. The officers of the company are: D. H. Smith, president; Thomas Tullock, vice president and superintendent, and W. J. McKean, secretary and treasurer. The new company will at once begin the manufacture of brass pipe and fittings of every sort.

The Crane Bros. Co., of Edmonds, Wash., has been incorporated with a capital of $10,000. The company will manufacture stoves and iron beds, and do other similar work. The incorporators are James J. Crane, J. W. Kramer and William Scharnweber.

The Eureka Brass Co. has been incorporated at St. Louis, Mo., with a capital of $50,000. The incorporators are Frank Haggenjos, Charles Erickson and John Haggenjos.

The Shepherd Steam Turbine & Mfg. Co., of Salt Lake City, Utah, has been incorporated with a capital of $100,000 and will conduct a manufacturing and foundry business. The officers of the company are Frank D. Shepherd, president: C. M. Chandler, vice president; C. B. Jack, secretary and treasurer. The company will make a specialty of the manufacture of steam turbines.

The Texas Co. has made arrangements to establish a foundry in connection with its pumping station at Sour Lake, Tex.

The Walsenburg Foundry & Mfg. Co., of Walsenburg, Colo., has been incorporated with a capital of $25,000. The incorporators are Jas. Autrey, Geo. Foruth, Adolph Unfug, J. B. Farr and Ernest Ruth.

The McPhail Molding Machine Mfg. Co., Davenport, Iowa, has been incorporated with a capital stock of $20,000. The company has equipped its plant with the necessary machinery, and is already doing business.

The Purcellville Foundry Co., of Purcellville, Va., has been incorporated with a capital stock of $15,000 to operate a foundry. The officers of the company are J. D. Dillon, president; and C. W. Case, secretary and treasurer.

The executive committee of the Buckeye Steel Castings Co., Columbus, O., is working on a plan of reorganization of the company. It is probable that the capital, which is now $1,000,000, will be raised to $2,500,000, divided into $1,000,000 preferred and $1,500,000 common, with $500,000 held in the treasury. The company owns two large plants and is paying 10 per cent dividends, though last year it earned almost 30 per cent. Frank Rockefeller is president, taking that position on the recent death of W. F. Goodspeed.

The Ferro Machine & Foundry Co., Cleveland, recently incorporated, has practically completed the taking over of the Hoffman Hinge & Foundry Co., of that city. Crispin Oglebay is president and treasurer and C. D. Campbell secretary.

The Mitchell-Parks Mfg. Co., St. Louis, has been incorporated to operate a machine shop and foundry. A frame building of good size will be erected. The officers are: John E. Mitchell, president, Dennis Parks, vice president; and J. N. Brown, secretary-treasurer. The office address is 1234 S. Seventh street.

The Mt. Vernon Car Mfg. Co., Mt. Vernon, Ill., is increasing the capacity of its works to 25 cars per day. New cupolas are being added to its foundry, additional machinery is being installed and new sidetracks laid about the plant.

The Star Manufacturing Co., Milwaukee, has been incorporated to conduct a general manufacturing and foundry business with a capital stock of $50,000. The incorporators are: Joseph

Scobis, Howland Russel and Henry Ferge.

The Gilleland Car & Foundry Co., St. Louis, Mo., has been incorporated with a capital stock of $5,000,000 with the following directors: Edgar B. Gilleland, and E. M. Markel, St. Louis; E. M. Markel Jr., Des Moines, Iowa; J. S. Faogerty and E. M. Markel, Arkansas City, Kan.; George H. Willis and J. Giles Smith, Wichita, Kan.; F. B. Gilleland, Crescent, A. J. Biddison, Pawnee, and William A. Knowles, Guthrie, Okla.

The Root Street Foundry Co., Chicago, has been incorporated with $15,000 capital stock by M. E. Herbert, John E. Hannan and John Wright.

The Michigan Copper & Brass Co., Detroit, Mich., has been incorporated with a capital stock of $1,000,000, to operate a copper and brass rolling mill. Among the incorporators are: M. J. Murphy, George H. Barbour, J. E. Dannaher and W. D. Carpenter.

The Mechanical Manufacturing Co., No. 419 Market street, Camden, N. J., mechanical engineers, tool makers, brass founders and metal workers, has been incorporated with a capital stock of $100,000. The incorporators are E. L. Smith, E. E. Pennock and John A. McPeak, all of the address given.

At the annual meeting of the Bristol Brass Co., Bristol, Conn., it was voted to increase the capital stock from $500,000 to $700,000, and the following officers were elected for the ensuing year: President, Pierce N. Welch, of New Haven; vice president and treasurer, J. R. Holley; secretary and assistant treasurer, Samuel B. Harper.

The Ansonia Mfg. Co., of Ansonia, Conn., has purchased the plant of the American Corundum Co., in Bridgeport, Conn. The buildings will be remodeled and the Ansonia Mfg. Co. will remove its works to Bridgeport. It is probable, however, that the firm name will not be changed.

The Putnam Foundry & Machine Corporation, of Putnam, Conn., elected the following officers at its annual meeting: President, Edward Mullan; vice president, Arthur C. Stetson; secretary and treasurer, William R. Barber; general manager, William R. Barber.

The Art Brass Co., of the Bronx, New York City, has been incorporated with a capital of $3,000. The incorporators are Arnold F. Riegger, and Frank H. Samuels, of 3 West 122nd street; William M. Cronyn, 840 East 141st street, all of New York City.

The Union Stove Works, of Peekskill,, N. Y., has secured the building of the old Peach Orchard Foundry, and will use it in connection with the stove foundry business.

The Thomas X. Lieb Brass Works, of Brooklyn, N. Y., has been incorporated with a capital of $4,000. The incorporators are Chas. P. Scott, 408 West 150th street; Thos. X. Lieb, 614 Marcy avenue; Wm. B. Farrell, 550 West 140th street, all of New York.

The Bailey-Farrell Mfg. Co., of Pittsburg, has sold its manufacturing plant at Rankin, Pa., to Geo. R. Acheson, son of Judge M. W. Acheson, former general manager of the company. The Bailey-Farrell Co. will abandon the manufacturing field entirely, and will devote its attention to jobbing business. The new firm will be known as the Acheson Mfg. Co., and will be incorporated with a capital of $300,000.

The Hart Valve Co., a New Jersey corporation, with a capital of $150,000, is to establish a new plant at Williamsport, Pa. The directors of the company are Walter Hart, George Hart, George W. Fleming and William L. Waltz, all of Williamsport; Albert E. Hart, of Kansas City, Mo.; Thomas B. Hall, of Camden, N. J., and William E. Mills, of Helena, Mont. The officers are Albert E. Hart, president; George W. Fleming, vice president; Walter Hart, secretary and treasurer.

The Uniontown Machine Co., of Uniontown, Pa., has consolidated its interests with the Charleroi Foundry & Machine Co., of Charleroi, Pa., and the plant will be moved from Uniontown to Charleroi.

The Richmond Mfg. Co., of Richmond, Va., has been formed by the consolidation of the Richmond Mfg. Co. and the Asa Snyder Co. The new concern has greatly enlarged the plant of the Asa Snyder Co., and now has an up-to-date foundry and manufacturing plant.

The plant of the Youngstown Furnace & Supply Co., of Youngstown, O., which was formerly the plant of the Sennett Foundry Co., has been entirely remodeled and newly equipped and is now in operation once more.

M. L. Hass and Edward Groff, of Tiffin, O., have formed a partnership to conduct a brass and aluminum foundry, the plant being located on River street.

The plant of the Burton Mfg. Co., of Burton, O., has been leased by Barberton, O., men who will form a company for the manufacture of gasoline engines.

The Parkhurst Mfg. Co., Peru, Ind., has started its new foundry. The foundry is equipped with modern machinery throughout, including a Newton cupola and cranes made by the Northern Engineering Works, Detroit, Mich.

The Gemmer Engine Works, of Marion, Ind., has been consolidated with the Barcus Foundry Co., at Wabash, Ind., and the engine works will be moved from Marion to Wabash.

A new company has been formed by John W. Brown, J. W. Rosbrugh, of Nappanee, Ind., and Frank Coats and Mr. Cregier, of Goshen, Ind., for the purpose of taking over the present steel tank business of the Brown Bros. Mfg. Co., at Nappanee, Ind., and adding to it a machine shop and foundry.

The Holland Foundry Co., of Warsaw, Ind., is to be consolidated with the Reynolds Furnace Co., of Chicago, and the plants of the latter company will be moved into the buildings formerly occupied by the Lesh Mfg. Co., of Warsaw.

The Chicago Pneumatic Tool Company, Chicago, Ill., has been awarded a gold medal at the Liege Exposition, covering pneumatic tools and appliances, and a silver medal for Franklin Air Compressors.

The S. Obermayer Co. has recently purchased the foundry supply factory of H. S. Vrooman of Chicago. The entire factory of this concern as well as their stock of merchandise has been moved to the Chicago plant of the S. Obermayer Co., which will fill all orders of this department.

A new foundry and machine shop is to be started in Ottawa, Ill., by G. C. Rickley and August Schmid.

The Elizabeth Street Foundry, Chicago, has increased its capital stock from $15,000 to $25,000.

The Riverside Foundry Co., of Kalamazoo, Mich., has doubled its capacity during the past year. The old officers and directors were re-elected for another year, as follows: president, M. J. Bigelow; vice president, Willis N. Pomeroy; financial secretary and treasurer, H. Manvel; recording secretary and manager, M. F. Richardson.

Mr. Fitch has retired from the Fitch-Morency Brass Foundry Co., of Sturgis, Mich., having sold his interests to A. F. Morency, C. A. Miller and C. E. Erbsmehl. The business will be conducted under the name of the Morency Brass Co., of which C. A. Miller is president, A. F. Morency vice president, and C. E. Erbsmehl, secretary.

At the annual meeting of the directors of the Union Foundry Co., of Detroit, Mich., the following officers were elected for the ensuing year: president, David Greig Jr.; vice president, Joseph Alz; secretary, Alfred Bury; treasurer, Alfred G. Eansor.

The Burns Boiler & Mfg. Co., of De Pere, Wis., has increased its capital stock from $100,000 to $200,000, to enable the company to increase its output. It is probable that the foundry will be enlarged somewhat.

Menzel & Jeffery, iron founders, of Minneapolis, Minn., inform us that the statement published concerning the Washburn Co. taking over the plant of Menzel Jeffery was misleading. The facts are that Menzel & Jeffery purchased land for a new factory in August, 1904, and since that time have purchased additional land adjoining it. They constructed a new works and abandoned the old plant which was then taken over by the Washburn Co. Menzel & Jeffery have just added a new building to take care of their sash weight foundry.

Steward's Iron Foundry, of Vineland, N. J., has been purchased by John G. Snowden, of Hughesville, Pa., and the plant will be enlarged.

The Cost of It

The expense of a modern system of cost-keeping need be no greater than a crude, antiquated and inefficient way of keeping accounts.

Such a system is accurate, quick and in ample detail, and it gives the detailed costs of every part of the work while the business is fresh—when it is most valuable as a basis of comparison.

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Production Engineers and Public Accountants.....

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The less favorable the conditions the greater the uncertainty.

The better the facings are, the less are the chances for rough unsightly castings.

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GENUINE EAST INDIA PLUMBAGO
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Chicago Pneumatic Tool Co., Chicago.
Curtis & Co. Mfg. Co., St. Louis.
Ingersoll-Rand Co., New York.
Norwalk Iron Works Co., So. Norwalk, Conn.

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New Era Mfg. Co., Kalamazoo, Mich.
Phosphor Bronze Smelting Co., Ltd., Philadelphia.

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Keep, W. J., Detroit.

Analysis—Chemical:

Metallurgical Laboratory, Pittsburg.

Anchors:

Lindsay & Co., W. W., Philadelphia.

Babbitt Metal:

Ajax Metal Co., Birmingham, Ala.

Barrels—Steel:

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Blowers:

American Blower Co., Detroit.
Connersville Blower Co., Connersville, Ind.
Cornell Co., J. B. & J. M., New York.
Roots Company, P. H. & F. M., Connersville, Ind.
Sturtevant Co., B. F., Boston.

Blowers—Positive Pressure:

Connersville Blower Co., Connersville, Ind.
Roots Co., P. H. & F. M., Connersville, Ind.
Sturtevant Co., B. F., Boston.

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Osborn Mfg. Co., Cleveland.

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Monarch Engineering & Mfg. Co., Baltimore.

Carbonese:

Midvale Mining & Mfg. Co., E. St. Louis, Ill.

Castings (Steel):

Otis Steel Co., Ltd., Cleveland.

Cement (Furnace):

Dixon Crucible Co., Jos., Jersey City.
Gautier & Co., J. H., Jersey City.

Cement (Metallic):

Clark Cast Steel Cement Co., Shelton, Conn.
Shelton Metallic Filler Co., Derby, Conn.
Smooth-On Mfg. Co., Jersey City.

Chaplets:

Burdick & Son, Albany.
Fanner Mfg. Co., Cleveland.
Lindsay & Co., W. W., Philadelphia.
U. S. Chaplet Co., New York.

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Gray, B. M., New York.
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Cores:

Brown Specialty Machry. Co., Chicago.

Core Binders:

Buckeye Milling Co., Cleveland.
Holland Linseed Oil Co., Chicago.
Millers' Products Co., Chicago.
Mills Oil Co., C. E., Syracuse.
National Jeloluse Co., New York.
Robeson Process Co., Camden, N. J.
Sterling Oil Co., Emlenton, Pa.

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Falls Rivet & Mch. Co., Cuyahoga Falls, O.
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Falls Rivet & Mch. Co., Cuyahoga Falls, O.
Millett Core Oven Co., Brightwood, Mass.
Paxson Co., J. W., Philadelphia.
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Bristol Co., Waterbury.

Cranes:

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Maris Bros., Philadelphia.
Niles-Bement Pond Co., New York.
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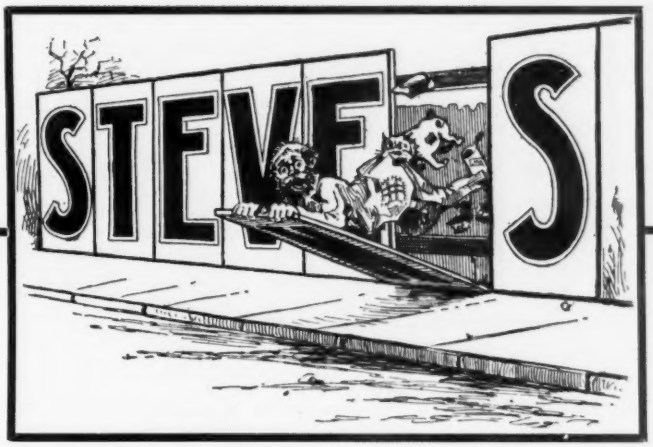

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I manufacture an entire line of polishing compositions—Tripoli, Crocus, Rouge, etc. These compositions are, from a practical point of view, the very best now on the market. The term "best" is a relative adjective, of course, and I use it in just that way, meaning that there is nothing so good offered today. If you will send that missing letter I will prove this statement.

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FREDERIC B. STEVENS

Corner Third and Larned Streets

DETROIT, MICH.

Crushers and Pulverizers:

Moussette, O. J., Brooklyn.

Crucibles:

Dixon Crucible Co., Jos., Jersey City.
Fair, Taylor & Co., San Francisco.
Gautier & Co., J. H., Jersey City.
McCullough-Dalzell Crucible Co., Pittsburg.
Paxson Co., J. W., Philadelphia.
Ross-Tacony Crucible Co., Philadelphia.
Taylor, Robt. J., Inc., Philadelphia.
Waterbury Crucible Co., Waterbury.

Cupolas:

Byram & Co., Detroit.
Gilmour, J., New York.
McCormick Co., J. S., Pittsburg.
Northern Engnrng Works, Detroit.
Paxson Co., J. W., Philadelphia.
Whiting Foundry Equipment Co., Harvey, Ill.

Cupola Linings:

McCormick Co., J. S., Pittsburg.
Paxson Co., J. W., Philadelphia.

Elevators:

Curtis & Co. Mfg. Co., St. Louis.
Ridgway & Son, Craig, Coatesville, Pa.

Engines (Gas):

Turner, Vaughn & Taylor Co., Cuyahoga Falls, O.

Engines (Steam):

American Blower Co., Detroit.
Sturtevant Co., B. F., Boston.

Engineers (Foundry, Mech., Elec., &c.):

Dodge & Day, Philadelphia.
Hooper, Geo. K., New York City.

Facings:

Buckeye Milling Co., Cleveland.
Buffalo Foundry Supply Co., Buffalo.
Dixon Crucible Co., Jos., Jersey City.
Hill & Griffith Co., Cincinnati.
McCormick Co., J. S., Pittsburg.
Moore's Facing Works, Providence.
Obermayer Co., S., Cincinnati.
Paxson Co., J. W., Philadelphia.
Smith Foundry Supply Co., J. D., Cleveland.
Stevens, F. B., Detroit.
Western Foundry Supply Co., E. St. Louis, Ill.

Fans:

American Blower Co., Detroit.

Ferro-Manganese:

Kendall & Flick, Washington, D. C.
Rogers, Brown & Co., Cincinnati.

Ferro-Silicon:

Raessler & Hasslacher Chemical Co., New York.
Rogers, Brown & Co., Cincinnati.

Fillers (Metallic):

Clark Cast Steel Cement Co., Shelton, Conn.
Shelton Metallic Filler Co., Derby, Conn.
Smooth-On Mfg. Co., Jersey City.

Fire Brick:

Gautier & Co., J. H., Jersey City.
Maurer & Son, Henry, New York.

Fire Sand:

Carborundum Co., Niagara Falls, N. Y.

Flasks:

Adams Co., Dubuque, Ia.
Barnett Fdy. Co., Oscar, Newark.
Brass Founders' Supply Co., Newark.

Flasks (Snap):

Adams Co., Dubuque, Ia.
Diamond Clamp & Flask Co., Richmond, Ind.
Obermayer Co., S., Cincinnati.
Smith & Caffrey Co., Syracuse, N. Y.

Flour:

Buckeye Milling Co., Cleveland.
Millers' Products Co., Chicago.

Foundry Equipment (Brass):

Barnett Fdy. Co., Oscar, Newark.
Obermayer Co., S., Cincinnati.
Stevens, F. B., Detroit.
Taylor, Robert J., Inc., Philadelphia.

Foundry Supplies:

Buffalo Fdy. Supply Co., Buffalo.
Caufman, S. H., Chester, Pa.
Cutter, Wood & Stevens Co., Boston.
Hill & Griffith Co., Cincinnati.
McCormick Co., J. S., Pittsburg.
Obermayer Co., S., Cincinnati.
Osborn Mfg. Co., Cleveland.
Paxson Co., J. W., Philadelphia.
Smith Foundry Supply Co., J. D., Cleveland.
Stevens, F. B., Detroit.
Taylor, Robert J., Inc., Philadelphia.

Furnaces (Melting):

Barnett Foundry Co., Oscar, Newark, N. J.
Hawley Down Draft Furnace Co., Chicago.
Monarch Engineering & Mfg. Co., Baltimore.
Paxson Co., J. W., Philadelphia.
Rockwell Engineering Co., New York.

Grinding Machinery:

Adams Co., Dubuque, Ia.
Bridgeport Safety Emery Wheel Co., Bridgeport, Conn.
Norton Emery Wheel Co., Worcester.

Grinding Wheels:

Norton Emery Wheel Co., Worcester.
Pike Mfg. Co., Pike, N. H.
Superior Corundum Wheel Co., Waltham, Mass.
Vitrified Wheel Co., Westfield, Mass.

Grinding Pans:

Crossley Mfg. Co., Trenton, N. J.

Hammers (Pneumatic Chipping):

Ingersoll-Rand Co., New York.

Continued on page 114.

C. E. Mills, Specialist

References given to the largest foundries in the country

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No. 1 for heavy work, No. 2 for light malleable work, fittings, etc. It goes twice as far as Flour and three times as far as Rosin. No blow and no absorption of moisture.

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Perfect adaptation for all work. Best Core Oil on the market.

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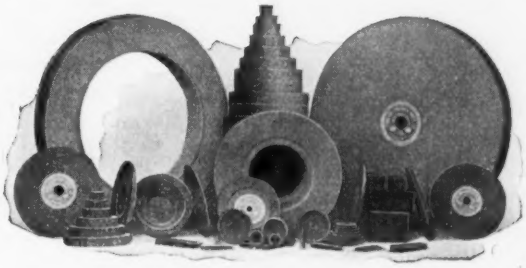

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PIKE, N. H.

Heating & Ventilating Apparatus:

American Blower Co., Detroit.
Sturtevant Co., B. F., Boston.

Hoists:

Curtis & Co., Mfg. Co., St. Louis.
Niles-Bement-Pond Co., New York.
Northern Engrg. Works, Detroit.
Pawling & Harnischfeger, Milwaukee.
Sellers & Co., Inc., William, Philadelphia.
Whiting Fdy. Equipment Co., Harvey, Ill.
Yale & Towne Mfg. Co., New York.

Hoists (Pneumatic):

Ridgway & Son, Craig, Coatesville, Pa.

Industrial Ry. Equipment:

Atlas Car & Mfg. Co., Cleveland.
Hunt Co., C. W., W. New Brighton, N. Y.

Iron Ore:

Rogers, Brown & Co., Cincinnati.

Ladles:

Northern Engrg. Works, Detroit.

Molding Machines:

Adams Co., Dubuque, Ia.
Arcade Manufacturing Co., Freeport, Ill.
Berkshire Mfg. Co., Cleveland.
Herman & Son, Chas., Sharpsburg, Pa.
McPhail Molding Machine Co., Davenport, Ia.
Manning, Maxwell & Moore, New York.
Mumford Co., E. H., Philadelphia.
Oregon Fdy. & Mach. Co., Oregon, Ill.
Paxson Co., J. W., Philadelphia.
Pridmore, Henry E., Chicago.
Tabor Mfg. Co., Philadelphia.
Turner Machine Co., Philadelphia.

Oil (Linseed):

Holland Linseed Oil Co., Chicago.

Packing (Rubber Sheet):

Smooth-On Mfg. Co., Jersey City.

Parting Materials:

Partamol Co., New York.

Patterns (Metal & Wood):

Gobeille Pattern Co., Cleveland.
Herman & Son, Chas., Sharpsburg, Pa.

Pattern Shop Equipment:

Fox Machine Co., Grand Rapids, Mich.

Phosphorizers:

McCullough-Dalzell Crucible Co., Pittsburg.

Phosphor Tin:

New Era Mfg. Co., Kalamazoo.

Pig Iron:

Addy & Co., Mathew, Cincinnati.
Baird & West, Detroit.
Bartlett & Co., N. S., Boston.
Brooks-Fenno & Co., J., Boston.
Cherry Valley Iron Co., Pittsburg.
Columbus Iron & Steel Co., Columbus.
Dalton, Nash & Co., New York.
De Camp Bros. & Yule, St. Louis.
Dimmick & Co., J. K., Buffalo.
Domhoff & Joyce Co., Cincinnati.
Field Sales Agency, Robert, Cincinnati.
Goodrich & Co., F. A., Detroit.
Hillman & Son, J. H., Pittsburg.
McKeefrey & Co., Leetonia, O.
Mohr, J. J., Philadelphia.
Pickands, Brown & Co., Chicago.
Pickands, Mather & Co., Cleveland.
Pilling & Crane, Philadelphia.
Republic Iron & Steel Co., Chicago & Birmingham.
Rogers, Brown & Co., Cincinnati.
Shepard, Chas. G., Buffalo.
Stevens, F. B., Detroit.
Thomas Furnace Co., Milwaukee.
Walter-Wallingford & Co., Cincinnati & Pittsburg.

Plumbago:

Buckeye Milling Co., Cleveland.
Dixon Crucible Co., Jos., Jersey City.
Gautier & Co., J. H., Jersey City.
Hill & Griffith Co., Cincinnati.
McCullough-Dalzell Crucible Co., Pittsburg.
Obermayer Co., S., Cincinnati.
Pettinos Bros., Bethlehem, Pa.
Ross-Tacony Crucible Co., Philadelphia.
Stevens, F. B., Detroit.

Polishers' & Platers' Supplies:

Stevens, F. B., Detroit.

Riddles:

Adams Co., Dubuque, Ia.
U. S. Chaplet Co., New York.

Sand:

Buffalo Fdy. Supply Co., Buffalo.
Cutter, Wood & Stevens Co., Boston.
Paxson Co., J. W., Philadelphia.
Stevens, F. B., Detroit.

Sand Blast Machinery:

Drucklieb, C., New York.
Tilghman-Brooksbank Sand Blast Co., Philadelphia.

Sand Mixing Machinery:

Falls Rivet & Machine Co., Cuyahoga Falls, O.
Sellers & Co., Inc., William, Philadelphia.
Standard Sand & Machine Co., Cleveland.

Sand Sifters:

Deane Steam Pump Co., Holyoke, Mass.
Hanna Engrg. Works, Chicago.
Herman & Son, Chas., Sharpsburg, Pa.
Standard Sand & Machine Co., Cleveland.

Saws (Cold Cutting):

Tabor Mfg. Co., Philadelphia.

Continued on page 116.

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The BEST WHEEL for your FOUNDRY
Made in Any Size or Shape
Free and Fast Cutting --- Uniform Quality
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Seacoal:
Hill & Griffith Co., Cincinnati.
Obermayer Co., S., Cincinnati.
Paxson Co., J. W., Philadelphia.

Separators (Magnetic):
Burlin, Chas. T., Whitinsville, Mass.
Dings Electro Magnetic Sep. Co., Milwaukee.
Elm City Engineering Co., New Haven.

Shafting (Flexible):
Coates Clipper Mfg. Co., Worcester, Mass.
Stow Mfg. Co., Binghamton, N. Y.

Shoes (Molders' Fireproof):
Brandau, Adam, Detroit.

Shovels:
Channon Co., H., Chicago.
Stevens, F. B., Detroit.

Silica Wash:
Buffalo Fdy. Supply Co., Buffalo.

Soil Pipe Equipment.
Oregon Fdy. & Mach. Co., Oregon, Ill.

Sprue Cutters:
Barnett Fdy. Co., Oscar, Newark.
Shuster Co., F. B., New Haven.
Waterbury Farrel Fdy., Waterbury, Conn.

Stoppers:
McCullough-Dalzell Crucible Co., Pittsburg.
Ross-Tacony Crucible Co., Philadelphia.
Taylor, Robert J., Inc., Philadelphia.

Stove Trimmings:
Burdick & Son, Albany, N. Y.
Fanner Mfg. Co., Cleveland.

Testing Machines:
Keep, W. J., Detroit.

Thermit Process:
Goldschmidt Thermit Co., New York.

Tools (Molders'):
Dobson, William, Canastota, N. Y.
Obermayer Co., S., Cincinnati.
Smith Foundry Supply Co., J. D., Cleveland.

Tools (Pneumatic):
Dayton Pneumatic Tool Co., Dayton.
Ingersoll-Rand Co., New York.

Trolley Track:
New Jersey Foundry & Machine Co., New York.

Tumbling Mills:
Adams Co., Dubuque, Ia.
Falls Rivet & Mch. Co., Cuyahoga Falls, O.
Gilmour, J., New York.
Waterbury Farrel Fdy., Waterbury, Conn.

Wire Straighteners:
Shuster Co., F. B., New Haven.
Blake Mfg. Co., Geo. F., New York City.

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Don't clean your castings by hand methods. Life's too short. Be up-to-date. Use an ***"Economy" Steel Wire Wheel Brush.*** *A great labor-saver. Does the work of five men. For every piece of work you finish by hand methods, your competitor with an* ***"Economy" Brush*** *is doing five times as much in the same time, and it's better work, too.*

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